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June 9, 2014

Ms. Betsy Burns
Remedial Project Manager
US EPA, Region 8 Montana Office
Federal Building
10 West 15th Street, Suite 3200
Helena, MT 59626

Subject: East Helena Superfund Site Remedial Design
Soil Sampling Program Quality Assurance Project Plan, Revision 1
Work Assignment No. 132-RDRD-0830
Contract No. EP-W-06-006

Dear Ms. Burns:

Pacific Western Technologies, Ltd. (PWT) is pleased to submit the Soil Sampling Program Quality Assurance Project Plan Revision 1 for the East Helena Superfund Site, East Helena, Montana. The Plan is relevant for actions pursuant to the Statement of Work for Remedial Design sampling activities performed by PWT.

If you have any questions or comments regarding this submittal, please do not hesitate to contact me by phone at (406) 457-5495 or email at greg.hayes@PWT.com.

Sincerely,

Greg Hayes

Greg Hayes, Project Manager
Pacific Western Technologies, Ltd.

Attachments: Quality Assurance Project Plan

REMEDIAL DESIGN
East Helena Superfund Site, Residential Soils and Undeveloped Lands (OU2)
Lewis & Clark County and Jefferson County, Montana

PACIFIC WESTERN TECHNOLOGIES, LTD.

SOIL SAMPLING PROGRAM
QUALITY ASSURANCE PROJECT PLAN

Prepared for:

U.S. Environmental Protection Agency
Region VIII
10 West 15th Street, Suite 3200
Helena, Montana 59626

Revision 1

Work Assignment No.	132-RDRD-0830
U.S. EPA Contract No.	EP-W-06-006
EPA Remedial Project Manager:	Betsy Burns
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PWT Team WA/Project Manager:	Gregory Hayes
Phone Number:	(406) 457-5495
Date:	June 9, 2014

REMEDIAL DESIGN
East Helena Superfund Site, Residential Soils and Undeveloped Lands (OU2)
Lewis & Clark County and Jefferson County, Montana

SOIL SAMPLING PROGRAM
QUALITY ASSURANCE PROJECT PLAN

Revision 1

Work Assignment No. 132-RDRD-0830
U.S. EPA Contract No. EP-W-06-006

June 9, 2014
QAPP, Revision 1 Period of Performance: June 9, 2014 through December 31, 2015

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Betsy Burns
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Document Revision Log

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0	9/27/13	New Document to EPA for review
1	5/5/14	Revised to Incorporate EPA comments
1	6/9/14	Revised to Incorporate EPA comments

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LIST OF ACRONYMS AND ABBREVIATIONS

BNSF	Burlington Northern Santa Fe Railway
CFR	Code of Federal Regulations
CLP	EPA Contract Laboratory Program
CPR	cardio-pulmonary resuscitation
CRQL	contract required quantitation limits
DEQ	Montana Department of Environmental Quality
DQO	Data Quality Objective
EDD	electronic data deliverable
EPA	U.S. Environmental Protection Agency
FSP	Field Sampling Plan
GIS	geographic information system
HASP	Site-Specific Health and Safety Plan
HAZWOPER	Hazardous Waste Operations and Emergency Response
IDW	investigation-derived waste
LEAP	Lewis & Clark County Lead Education and Abatement Program
LTMRS	Long-Term Monitoring of Remediated Sites
MDL	method detection limit
MRL	method reporting limit
MS	matrix spike
MSD	matrix spike duplicate
MTRL	Montana Rail Link
OSHA	Occupational Safety and Health Administration
OU2	Operable Unit 2
ppm	parts per million
PWT	Pacific Western Technologies, Ltd
QA	quality assurance
QAO	Quality Assurance Officer
QAPP	Quality Assurance Project Plan
QC	quality control
RAC	Remedial Action Contract
RD	remedial design
ROD	Record of Decision
ROW	right-of-way
RPD	relative percent difference
RPM	EPA Remedial Project Manager
Site	East Helena Superfund Site OU2
SOP	standard operating procedure
TTEMI	Tetra Tech, EMI

1.0 INTRODUCTION

The East Helena Superfund Site Operable Unit 2 (Site) is depicted on Figure 1 and includes the decommissioned ASARCO smelter, an industrial facility operated by American Chemet Corporation, all of the City of East Helena, Montana, nearby residential subdivisions, numerous rural developments such as farms and homes on small acreage plots, and surrounding undeveloped lands including several large farms or ranches and their associated cultivated fields or pastures, extending into Lewis and Clark County and Jefferson County. The U. S. Environmental Protection Agency (EPA) Site Identification Number for the East Helena Superfund Site is MTD006230346.

Activities at the Site relating to this Quality Assurance Project Plan (QAPP) are being conducted in accordance with the *Final Record of Decision, East Helena Superfund Site, Operable Unit No. 2, Residential Soils and Undeveloped Lands* (ROD) (USEPA 2009a). As described in the ROD, the selected remedy addresses Operable Unit 2 (OU2), East Helena Residential Soils and Undeveloped Lands, which consist of surface soils on residential properties, rural developments, and surrounding agricultural land, excluding former smelter property. The remedial design (RD) will be conducted in accordance with the ROD with EPA as the lead agency for the Site and the State of Montana Department of Environmental Quality (DEQ) as the supporting agency. Table 1 identifies and provides contact information for key project personnel.

Under Remedial Action Contract (RAC) No. EP-W-06-006, the EPA Region 8 has requested Pacific Western Technologies, Ltd. (PWT) to develop a Soil Sampling QAPP for the RD at OU2. While this QAPP applies to work being performed throughout the Site, the majority of the work being performed will be in and near the town of East Helena. A Site Layout map identifying pertinent features is shown on Figure 2.

This document describes collection and analysis of soil samples at select residential, commercial, or public properties, unpaved road aprons or alleys (collectively referred to as properties), and the railroad right-of-way (ROW) within the Site. To detail the sampling locations, rationale, and schedule for the three different types of sampling activities that are currently expected to occur, PWT will develop separate activity-specific Field Sampling Plans (FSPs). These FSPs include:

- <u>Residential Soil Sampling FSP</u>, which will cover all 2013, 2014, and 2015 sampling of previously unsampled residential yards to complete the RD. (PWT 2013b).
- <u>Railroad ROW Soil Sampling FSP</u>, which will cover any 2014 or 2015 sampling of the Burlington Northern Santa Fe Railway Company (BNSF), Montana Rail Link (MTRL), and/or ASARCO railroad ROW within the Site boundaries to complete the RD. The preparation of this FSP is expected to occur after PWT is directed by the EPA to conduct the railroad ROW sampling.
- <u>Long-Term Monitoring of Remediated Sites (LTMRS) Soil Sampling FSP</u>, which will detail the continuous sampling scheme for selected previously remediated properties in order to monitor the effectiveness of remediation and to ensure that re-contamination is not occurring.

The purpose of this QAPP is to describe the procedures for obtaining access; mobilization and demobilization; field soil sample collection activities; sample preparation, handling and laboratory analysis; remedial design data collection efforts; field and analytical data management; quality assurance (QA) and quality control (QC) measures and protocols; investigation-derived waste (IDW) management; and other site-related activities during the RD.

This document has been prepared in accordance with the *EPA Requirements for Quality Assurance Project Plans* (USEPA 2001) and in general accordance with the *EPA Guidance for Quality Assurance*

Project Plans (USEPA 2002). The objective of this QAPP is to establish the data objectives to ensure appropriate quality and quantity of data collected that is necessary to support development of the RD.

This QAPP also provides definitions of the project data quality requirements necessary to meet the data objectives for these field programs. The EPA's *Guidance on Systematic Planning Using the Data Quality Objective Process* (USEPA 2006a) was consulted frequently while preparing this QAPP and the seven-step data quality objective (DQO) process, presented in Section 4. This QAPP describes the field and analytical procedures that will be used to ensure that data collected during these field programs are of sufficient quality to meet the project objectives. The following four main groups of elements are included in this QAPP:

- Project Management
- Data Generation and Acquisition
- Assessment and Oversight
- Data Validation and Usability

2.0 PROJECT ORGANIZATION AND RESPONSIBILITIES

This section identifies key individuals for all major aspects of the project from management and planning through field sample collection and laboratory analysis and data management, and discusses their responsibilities. Figure 3 presents a project organizational chart. Table 1 provides the contact information for each of the individuals noted in this section.

2.1 MANAGEMENT RESPONSIBILITIES

2.1.1 U.S. Environmental Protection Agency

Ms. Betsy Burns is the EPA Remedial Project Manager (RPM) and the primary EPA contact for all aspects of the work concerning OU2, Residential Soils and Undeveloped Lands. Ms. Burns has overall responsibility for this portion of the project and also is responsible for coordinating communication between the EPA, the DEQ, and the public. As RPM, she will be responsible for the both the overall contractual management and the overall technical management of this project under the RAC2 Region 8 Contract. Ms. Burns will also be responsible for day-to-day technical and financial management of this project, including the terms and conditions and budget contained in the approved Remedial Design Contractor Work Plan for this work assignment. Additionally, she will monitor the project for conformance with the signed contract clauses, provide consent authority for changes in scope and cost, and monitor the project for conformance with the scope of work contained in the EPA Statement of Work and the approved Remedial Design Contractor Work Plan for this work assignment. The RPM will communicate directly with the PWT Team Project Manager, Mr. Greg Hayes, and as necessary with the PWT Team RAC2 Region 8 Contract Program Manager, Dr. Ram Ramaswami.

2.1.2 State of Montana Department of Environmental Quality

As per the State Cooperative Agreement with the EPA for this project, the DEQ is the support agency. Mr. Daryl Reed is the DEQ Project Officer for the Site and, as the primary DEQ site contact, works directly with Ms. Burns in regulatory oversight and management of the project. The DEQ will participate in various aspects of the project, including meetings, field oversight, investigation activities, community relations, and public meetings, and will have opportunities to review the project files upon making advance requests to the EPA.

2.1.3 Remedial Design Contractor

The PWT Team is the Remedial Design Contractor. Mr. Greg Hayes is the Project Manager and main point of contact for the PWT Team, including partnering companies and any subcontractors. Mr. Hayes will be responsible for day-to-day communication with the RPM as well as with the PWT Team staff assigned to perform various project tasks. He will be responsible for the contractual commitments and for ensuring that the necessary resources are dedicated to the project. Mr. Hayes is responsible for maintaining and updating the approved QAPP for the project; he is also responsible for distributing the revised QAPP when appropriate. As Project Manager, he will define and clarify the scope of work and objectives for the supplemental sampling program and see that the technical, budget, and schedule requirements are met. Supporting Mr. Hayes in his capacity as Project Manager is PWT Team's RAC2 Program Manager. Dr. Ram Ramaswami has overall responsibility for the successful execution and completion of the work assignments under the RAC2 Region 8 Contract.

PWT has teamed with Tetra Tech EM Inc. (TTEMI) to provide environmental services support on this project. TTEMI's support is described in Section 2.2.4.

2.2 PROJECT RESPONSIBILITIES

2.2.1 PWT Team Field Team Leader

The Field Team Leader is Mr. Greg Hayes. In this capacity, Mr. Hayes is responsible for leading and coordinating the day-to-day sampling activities. During the sampling activities, the Field Team Leader's responsibilities will include:

- On-site Health and Safety coordination pursuant to the PWT Site-Specific Health and Safety Plan (HASP) (PWT 2013a)
- Development and implementation of field-related work plans, assurance of schedule compliance, and adherence to management-developed study requirements
- Coordination and management of field staff
- Implementation of QC for technical data provided by the field staff including field measurement data
- Adherence to work schedules
- Generation, review, and approval of text and graphics required for field team efforts
- Coordination and oversight of technical efforts of subcontractors
- Identification of problems at the field-team level and discussion of resolutions between the field team and upper management.

2.2.2 PWT Team Quality Assurance Officer

The Quality Assurance Officer (QAO) for this project is Mrs. Robin Witt. As the QAO, Mrs. Witt will remain independent of direct project involvement and day-to-day operations. She is responsible for determining that the QA program defined in the QAPP and the RAC2 Quality Management Plan is implemented. In addition, she will evaluate whether the project follows the EPA and PWT policies and requirements. Her specific responsibilities include:

- Conducting field QA audits, or directing that such audits be conducted by other qualified members of the project technical staff
- Reviewing and approving QA plans and procedures, including reviewing updates to this QAPP as appropriate
- Providing technical assistance to project staff for QA issues.

Mrs. Witt, or her designee, may perform an audit of field activities and documentation to assure compliance with PWT policies and this QAPP. Findings of the audit will be reported to the Project Manager and maintained in the project files. The QAO is also responsible for ensuring the prompt and complete implementation of any corrective or preventive actions selected to address specific QA audit findings. Additional information regarding audits, assessments, and response actions is discussed in Section 13 of this QAPP.

2.2.3 PWT Team Project Chemist

The Project Chemist for this project is Ms. Deborah Kutsal, from Tetra Tech. Her responsibilities include, but are not limited to:

- Reviewing analytical data to ensure conformance with QA testing and standards, performing data validation and verification, and approving analytical data
- Interfacing with the laboratory on matters concerning chemical sampling and analysis, laboratory reports, verifications and validation of data, and the resolution of nonconforming activities or data
- Identifying, reporting, and recommending solutions for nonconforming sampling or analytical activities or data
- Serving as a point of contact for issues related to environmental chemistry.

The EPA Analytical Program may perform an audit of the EPA's Contract Laboratory Program (CLP) laboratory to determine laboratory capability to implement method and contract-specified aspects of work.

2.2.4 PWT Team Technical Staff

The technical staff for this project will be selected from the PWT Team's corporate resources. The PWT Team may include not only PWT staff, but technical and clerical staff from TTEMI. The technical staff will gather and analyze data, and prepare various task reports. All of the designated technical staff will be experienced professionals who possess the degree of specialization and technical competence required to effectively and efficiently perform the required work.

2.3 LABORATORY RESPONSIBILITIES

The EPA's CLP laboratories will perform the chemical analysis of samples for this project. Table 2 lists the required analytical methodology and related information. Although a specific EPA laboratory has not been assigned to the project at this time, a general discussion of laboratory organization that represents the EPA Analytical Program standards is presented in this section. Ensuring that each laboratory has, or requiring each laboratory to demonstrate that it can perform the analytical methods and meet the criteria specified in this QAPP, is the responsibility of the EPA Analytical Program Manager, Mr. Donald Goodrich. Once the EPA CLP laboratory has been assigned, Table 1 will be updated, identifying the laboratory and the key personnel listed below, including contact information.

A complete description of the EPA Analytical Program can be found at: http://www.epa.gov/superfund/programs/clp/index.htm. All CLP laboratories follow the same QA/QC program. The statement of work for the CLP's Inorganic analytical method, ISM01.3, which will be utilized for this project, can be found at: http://epa.gov/superfund/programs/clp/ism1.htm. These statement of work documents constitute the technical and contractual framework for commercial environmental testing laboratories to apply analytical methods for the isolation, detection and quantitative measurement of environmental samples. This includes a summary of requirements, reporting and deliverable requirements, a target compound list and contract required quantitation limits, analytical methods, quality assurance/quality control requirements, chain-of-custody, document control, and SOPs, a glossary of terms, and a data dictionary and format for data deliverables in computer-readable format. The EPA Analytical Program simplifies the DQO process by pre-defining elements such as analytical methods, laboratory equipment maintenance and calibration, sample shipment chain-of-custody procedures and forms, analytical precision and accuracy, sample disposal procedures, QC requirements, data management, and documentation. The EPA's Analytical Program Manager will communicate directly with the RPM.

2.3.1 Laboratory Project Manager

The Laboratory Project Manager will be the primary contact at the laboratory for the EPA Laboratory Program Manager, who will interface with PWT and will be responsible for assuring that the project laboratory requirements are met. The Laboratory Project Manager will be responsible for scheduling sample analysis and will ensure that the data are generated in accordance with the specifications presented in this QAPP. The Laboratory Project Manager will also be responsible for monitoring the progress and timeliness of the laboratory work, reviewing work orders and laboratory reports, and processing any changes in the scope of work. In addition, the Laboratory Project Manager will be responsible for approving final analytical reports prior to submission to the Sample Management Office Website and for ensuring that project-specific corrective actions are taken when necessary to address problems identified by the QC sample results or QA audit results.

2.3.2 Laboratory Project Quality Assurance Officer

The Laboratory Project Manager will assign a Laboratory Project QAO who will be responsible for assuring that the laboratory QA/QC activities are performed in accordance with the requirements specified in both this QAPP and the laboratory's internal QA plan. Responsibilities will include (but are not limited to) preparing QA documents that define QA/QC procedures, reviewing and approving laboratory QC procedures, and oversight of inter-laboratory testing programs and laboratory certifications. The Laboratory Project QAO will also be responsible for monitoring method operations through periodic reviews and technical system audits. Unacceptable findings will be reported to the EPA's Analytical Program Manager for determination of corrective action.

2.3.3 Laboratory Sample Custodian

The laboratory will assign a designated Sample Custodian that reports to the Laboratory Project Manager or other designated individual and is responsible for:

- Receiving and inspecting samples
- Recording information regarding sample condition upon receipt and signing the appropriate forms
- Verifying the chain-of-custody and documenting any discrepancies
- Notifying the Laboratory Project Manager or other appropriate laboratory personnel of sample receipt and inspection
- Assigning a unique identification number and customer number to each sample and logging it into the sample receiving log book and laboratory information management system
- Transferring samples to the appropriate laboratory sections
- Controlling and monitoring access to and storage of samples and extracts.

2.4 TRAINING

All staff associated with this project will have sufficient training to safely, effectively, and efficiently perform their assigned tasks. Training will be provided to project personnel to insure compliance with the PWT HASP (PWT 2013a) and technical competence in performing the work effort.

All field personnel will read this QAPP, the applicable FSP, and the PWT HASP and will have sufficient training to assure compliance with health and safety issues and to meet the technical requirements of this project. The Field Team Leader will ensure that a hard copy of this QAPP, the applicable FSP, and the PWT HASP are kept in the field vehicle for ready access during all field operations.

In accordance with the PWT HASP, field personnel will have satisfactorily completed the Occupational Safety and Health Administration (OSHA) 40-hour Health and Safety Course for Hazardous Waste Operations and Emergency Response (HAZWOPER) Training in accordance with Sections e and p of the OSHA 29 Code of Federal Regulations (CFR) 1910.120. This certification will be maintained with annual HAZWOPER Refresher Training as required by Sections e and q of 29 CFR 1910.120. Field staff will have completed certification in First Aid and Adult Cardio-Pulmonary Resuscitation (CPR) Training. Adult CPR and First Aid Training recertification will be performed every two years. All personnel will also have a minimum of three days of actual field experience under the direct supervision of a trained, experienced supervisor. The Field Team Leader will also have completed the OSHA eight-hour HAZWOPER Supervisor Training prior to field activities.

The Project Manager will ensure all on-site personnel have the appropriate training and maintain copies of the training certificates in the PWT Helena, Montana office, approximately seven miles from the Site.

3.0 PROJECT DESCRIPTION AND BACKGROUND

3.1 PROBLEM DEFINITION

This QAPP details the planning and implementation steps necessary to collect additional soil data in order to achieve two main goals. The first goal is to use the analytical data collected from sampling previously unsampled properties and from the railroad ROW to design the remedial action components for the Site. The DQOs for the first goal are found in DQO 1 and DQO 2. The second goal is to sample previously remediated properties as part of the LTMRS program, and is related to DQO 3. This program is based on the original Long-Term Monitoring program, which was started in 1992, amended in 2003, and suspended in 2009. Its goal was to sample previously remediated properties and compare these sample results with analytical data obtained during post-removal sampling in order to monitor the effectiveness of the remediation activities, as well as to monitor for the potential reintroduction of metals in replaced soils.

3.2 SITE HISTORY AND BACKGROUND

The City of East Helena, Montana is located three miles east of Helena, Montana (Figure 1). According to the 2010 census, East Helena has a population of 1,984 people. The East Helena Superfund Site consists of the former ASARCO smelter facility, all of the City of East Helena, Montana, nearby residential subdivisions, numerous rural developments such as farms and homes on small acreage plots, and surrounding undeveloped lands including several large farms or ranches and their associated cultivated fields or pastures, extending into Lewis and Clark County and Jefferson County (Figure 2). Smelting operations at the Site began in 1888. ASARCO bought the property in 1895 from Helena and Livingston Lead Smelting and continued operations until the smelter was closed in 2001. Residential areas of East Helena are within one-quarter mile of the former smelter area (USEPA 2009a).

Concerns of contamination led the State of Montana to initiate environmental and human health investigations in the early 1970's that revealed high levels of lead, arsenic, cadmium, copper and zinc in the air, soil, surface water, and dust in and around the city of East Helena. The identified sources of this contamination were the smelter stack, fugitive emissions from plant operations, process ponds, and direct surface water discharges. Historically, the migration pathways for the contaminants were through air and surface water. A preliminary assessment of the Site was conducted in 1981 and a Site inspection was conducted in 1983. In September 1984, EPA listed the Site on the National Priorities List pursuant to Section 105 of the Comprehensive Environmental Response, Compensation and Liability Act (USEPA 2009a).

Currently, the EPA recognizes two OUs associated with the Site; these include OU1 – Process Ponds, and OU2. OU2 consists of non-smelter property soils of residential areas, rural developments, and surrounding undeveloped lands (including unpaved streets, aprons, alleys, irrigation ditches, and railroad ROWs). OU2 also includes certain formerly ASARCO-owned properties, such as Lamping Fields, the Dartman parcel, and the East Fields east of State Highway 518. A ROD outlining the selected remedy for OU2 was issued by the EPA on September 19, 2009 (USEPA 2009a). The selected remedy includes residential soil excavation and disposal in an EPA-approved repository, cleanup of undeveloped lands as land use changes necessitate, and institutional controls to protect the integrity of the completed actions.

The Lewis and Clark County Lead Education and Abatement Program (LEAP) was established in East Helena to promote lead awareness and provide free environmental assessments for all residents of the East Helena Superfund Site. The program also provides information to the public about lead awareness and abatement in homes, day care establishments, schools, and information to residents regarding areas to avoid. Additionally, LEAP provides information to purchasers and sellers of properties regarding property conditions specific to the Site.

In 1991, ASARCO began a series of non-time critical removal actions to remove contaminated soils from residential areas, parks, playgrounds, streets, and alleys in East Helena. A majority of the residential removal action was conducted from 1991 to 1996, and continued through 2011. By the end of 2011, removal action had occurred at 786 residential properties, 50 commercial properties, 373 unpaved road aprons, 75 unpaved alleys, 14 unpaved roadways, 11 parks or public areas, 4 school playgrounds or church properties, 4,200 linear feet of irrigation ditch, 141 flood channel sections, 80 flood ditch sections, 4 parking lots, and 38 vacant lots.

Non time-critical removal actions conducted between 1991 and 2011 addressed properties containing soils with lead concentrations in excess of 1,000 parts per million (ppm). Any sample analytical result of 1,000 ppm lead or greater triggered a removal action of the exposed soil at a property. Soil was removed from the properties to a depth at which the final excavated surface contained no lead concentrations greater than 500 ppm or to a maximum depth specific to the property use. It was expected that using this methodology relating to elevated lead concentrations would also address arsenic contamination.

Pursuant to the third Five Year Review (USEPA 2011), there are an estimated 85 properties that still require remediation. Additionally, there are a number of residential properties and sections of the railroad ROW that either have never been sampled for metals contamination or require additional sampling to determine if they require remediation. There are also a number of previously remediated properties that were part of an ongoing long-term monitoring program to ensure re-contamination of soils, through wind or storm water transport mechanisms, is not occurring. Pursuant to the request of the EPA, this monitoring program will be continued, with possible additions of remediated properties to the long-term monitoring list.

This QAPP addresses sampling activities in OU2, including collecting soil samples, as well as preparing and shipping the samples to an EPA CLP laboratory for analysis of metals. The current contaminants of concern at the Site are arsenic and lead.

3.3 REMEDIAL ACTION COMPONENTS

The selected remedy for the Site includes excavation and replacement of contaminated soils and material followed by transport of the contaminated materials to an EPA-approved secure repository for disposal. The selected remedy also includes institutional controls.

The major components of the selected remedy, as defined in the ROD for OU2 (USEPA 2009a) are:

- Excavating contaminated soil remaining in qualified residential yards and vacant lots and disposal in an EPA-approved soil repository. A lead cleanup level of 1,000/500 ppm will be applied to residential yards. When any section of a yard is found to have a soil lead concentration greater than 1,000 ppm, all portions of the yard with soil lead greater than 500 ppm will also be cleaned up. Soil from excavated areas will be replaced with clean topsoil, revegetated and landscaped.
- Yards where the yard-wide average soil arsenic concentration exceeds 100 ppm will be cleaned up regardless of the lead concentration. The cleanup action level for arsenic is expected to achieve a community-wide post cleanup average arsenic concentration that is substantially less than 100 ppm. The result will be protective of human health.
- Unpaved streets, aprons, and alleys of residential areas, with lead levels greater than 1,000 ppm or arsenic levels greater than 100 ppm, will be cleaned up.
- Historic irrigation ditches and water spreading channels that contain lead concentrations above 1,000 ppm or arsenic levels above 100 ppm will be cleaned up when they are located within or in close proximity to residential areas. Portions of the railroad ROW that are adjacent to residential areas, and where the lead concentration exceeds 1,000 ppm or arsenic levels exceed 100 ppm, will be cleaned up.

- Excavated contaminated soil will be disposed in an EPA-approved soil repository.
- EPA anticipates that the Lewis and Clark County Board of Health and City of East Helena will establish and administer local regulations to protect the selected remedy. Institutional controls are required for residential areas, agricultural lands, and all undeveloped lands proposed for development. Institutional controls are discussed more fully in Section 12.
- The community-wide education program, designed to monitor and protect children against exposures to residual lead, will be continued for as long as Lewis and Clark County health professionals, in consultation with other federal, state and local health officials, deem it to be necessary and beneficial.
- Undeveloped land will be evaluated whenever a change in land use is proposed and, if necessary, cleaned up to appropriate levels for the proposed use. A lead cleanup level of 500 ppm and arsenic cleanup level of 100 ppm in soil will be applied to undeveloped land proposed for residential development in the future. Separate lead and arsenic cleanup levels will be applied to undeveloped lands proposed for future commercial or recreational use.

Sampling and analysis performed pursuant to this QAPP will support the implementation of the first two remedial components involving properties, as well as the railroad ROW sampling component. Based on discussions with the EPA, PWT does not anticipate other sampling activities relating to the remedial design will be necessary under this work assignment (e.g., unpaved streets, aprons, and alleys, irrigation ditches, etc.). If one of these sampling activities does become necessary, this QAPP will be amended and an activity-specific FSP will be created for the new sampling activity.

3.4 REMEDIAL ACTION LEVELS

The ROD (USEPA 2009a) establishes two part soil action levels of 1,000/500 ppm lead for the existing residential and public use areas of East Helena. This means that if any sampling unit contains soil lead levels greater than 1,000 ppm, then all sampling units within that property with soil lead levels above 500 ppm will be remediated. Properties where the yard-wide average soil arsenic concentration exceeds 100 ppm arsenic will be remediated regardless of the lead concentration.

The sections of railroad ROW that are adjacent to residential areas of East Helena or have pedestrian or vehicular crossings may pose a risk to human health if the soil has elevated levels of lead or arsenic. There were several limited soil investigations conducted in the railroad ROW in 1997 and 1998, which concluded that although elevated levels of lead and arsenic are present, a more in depth study is necessary to adequately characterize the nature and extent of contamination and the possible need for remediation. The analytical data from the previous railroad ROW studies showed lead contamination levels as high as 43,906 ppm and arsenic as high as 2,018 ppm (CH2M Hill 1998). The ROD (USEPA 2009a) establishes soil action levels of 1,000 ppm lead and 100 ppm arsenic for portions of the railroad ROW that are adjacent to residential areas.

For soil sampling activities relating to the LTMRS program, there have not been specific action levels established for soil lead or arsenic concentrations. The goal of the LTMRS program is to sample previously remediated properties and compare the analytical data with analytical data obtained during post-removal sampling in order to monitor the effectiveness of the remediation activities, as well as to monitor for the potential reintroduction of metals in replaced soils. Therefore, sample results generated from any LTMRS program sampling will be compared with post-removal sample results from the same sampling unit in the same yard.

3.5 REMEDY COMPONENTS, DATA EVALUATION AND NEEDS

Previous soil sampling of residential and commercial properties, unpaved streets, aprons, and alleys, vacant lots, agricultural lands, irrigation ditches, flood plains and flood channels, and portions of the railroad ROW has occurred in East Helena since the smelter site and East Helena Community and surrounding areas were classified as a Superfund site in 1984. Based on the results of these sampling activities, non-time critical soil removal action has occurred on many properties, as discussed in Section 3.2. The focus of this QAPP is to sample additional properties and railroad ROW segments that were not previously sampled, as access is obtained or additional locations are identified by the EPA, to determine if additional remediation is needed. In addition, sampling will be carried out relating to the LTMRS program, to monitor the effectiveness of remediation and to ensure that re-contamination of soils at previously remediated properties is not occurring.

3.6 PROJECT SCHEDULE

RD soil sampling of residential properties is expected begin during the spring of 2014 and continue through 2015 as more properties become available for sampling as PWT and the EPA will secure access from property owners. RD soil sampling of the railroad ROW is expected to occur during the summer or fall of 2014. Soil sampling relating to the LTMRS program will occur during the spring, summer and fall of 2014 and 2015.

Within 45 days of the receipt of analytical data from the laboratory, PWT will validate 10% and verify 100% the data and will support the EPA in comparing the results to ROD established action levels to determine is remedial action is warranted.

3.7 PROJECT CONSTRAINTS

Practical constraints may include adverse weather conditions or the ability to gain access agreements from property owners. Gaining access to private properties is often time consuming. Property owners change over time; therefore, contact information for each residence or property can be out of date or inaccurate. Calling and mailing requests to sample a property can be used to gain access to a residence, but people are often not home or ignore these requests. In-person visits may be required to gain access to some properties. Several visits may be necessary to catch the property owner when they are at home. The EPA will support PWT's efforts to secure access to any properties as needed. The EPA will secure access for the railroad ROW sampling event, as needed.

4.0 QUALITY OBJECTIVES AND CRITERIA

4.1 DATA QUALITY OBJECTIVES

DQOs are statements that define the type, quality, quantity, purpose, and use of data to be collected. The design of a study is closely tied to the DQOs, which serve as the basis for important decisions regarding key design features such as the number and location of samples to be collected and the chemical analyses to be performed.

The EPA has published a number of guidance documents on the DQO process (USEPA 1994, USEPA 2000, USEPA 2001, USEPA 2002, USEPA 2006a). This QAPP was developed in accordance with these guidance documents. In brief, the DQO process follows a seven-step process, as follows:

1. State the problem
2. Identify the decision
3. Identify the inputs to the decision
4. Define the boundaries of the study
5. Develop a decision rule
6. Specify the acceptable limits on decision errors
7. Optimize the design for obtaining data.

Following these seven steps helps ensure that the QAPP is carefully planned and that the data collected will provide sufficient information to support the key decisions that must be made. The following sections summarize the application of the 7-step DQO process to the design of the sampling plan for the three components of the RD soil sampling listed below:

- DQO 1 – Evaluate the nature and extent of soil contamination at each sampling unit of individual properties at the Site.
- DQO 2 – Evaluate the nature and lateral extent of soil contamination in the railroad ROW adjacent to residential areas at the Site.
- DQO 3 – Evaluate the concentrations of lead and arsenic in the soils of residential yards at the Site that have been previously remediated and have been included on a long-term monitoring list.

4.2 DQO 1 – EVALUATE THE NATURE AND EXTENT OF SOIL CONTAMINATION AT EACH SAMPLING UNIT OF INDIVIDUAL PROPERTIES AT THE SITE

4.2.1 DQO 1 – Step 1. State the Problem

The previous sampling efforts at the Site were focused on providing information about the nature and extent of soil contamination. Early efforts focused on collecting the data necessary to complete non-time critical soil removal actions of impacted areas in and near the community of East Helena. Additional soil data is needed from previously unsampled properties to determine if remedial action is required, and to prepare remedial designs where necessary.

4.2.2 DQO 1 – Step 2. Identify the Decision

The decision to be made is: Does lead contamination exist in soil within any sampling unit of the individual property above the ROD established action levels? Is the average arsenic contamination of the entire individual property above the ROD established action level?

4.2.3 DQO 1 – Step 3. Identify the Inputs to the Decision

The inputs to the decision include: Analytical results for arsenic and lead for applicable soil samples collected within each yard, dimensions of individual yards and yard subareas sampled (for calculation of yard wide average arsenic concentration), and ROD-identified action levels for arsenic and lead. Lead and arsenic concentrations will be determined by laboratory analysis using EPA Method 6010C. Analyses will be performed on composite samples collected from each sampling unit at 0 to 6 inches and 6 to 12 inches below ground surface.

4.2.4 DQO 1 – Step 4. Define the Study Boundaries

Spatial Boundaries

The lateral boundary for the investigation includes residential properties within and near the City of East Helena. The vertical boundaries for the investigation are from the ground surface to 12 inches below ground surface.

Temporal Boundary

The temporal boundary of the sample is the single, one-time collection of that sample, as metals concentrations are not expected to vary seasonally.

4.2.5 DQO 1 – Step 5. Develop a Decision Rule

Soil data from each sampling unit at each sampled depth will be compared to action levels established in the ROD. For lead, the previously established action levels are 1,000/ 500 ppm. When any sampling unit of a yard is found to have a soil lead concentration greater than 1,000 ppm, all portions of the yard with soil lead greater than 500 ppm will also be remediated. For arsenic, yards where the yard-wide average soil arsenic concentration exceeds 100 ppm will be remediated regardless of the lead concentration. Based on the risk to human health, if contamination is discovered above action levels established in the ROD in either depth (6 inches or 12 inches below ground surface), remediation will occur down to that depth.

4.2.6 DQO 1 – Step 6. Specify Acceptable Limits on Decision Errors

The potential for decision errors exists because all analytical measurements inherently contain sampling and measurement errors. Sampling design error occurs when the data collection scheme does not adequately address the inherent variability of the matrix being sampled. Measurement error occurs from the inherent variability in the collection, preparation, and analysis of an environmental sample. These errors will be minimized by following the procedures outlined in this QAPP, the associated FSP, and SOPs.

The null hypothesis is that the soil concentrations of lead and or arsenic exceed ROD-established action levels in one or more sampling units at a residential property. The alternate hypothesis is that soil concentrations do not exceed action levels in any sampling units at a property.

There are two types of decision errors of concern for this QAPP:

1. False Acceptance: Deciding that a property does require remedial action when in fact it does not.
2. False Rejection: Deciding that a property does not require remedial action when in fact it does.

The majority of potential decision errors are typically associated with field sample variability and collection procedures. Analytical error is usually a much smaller portion of the total error associated with an environmental measurement; however the analytical data must be reported by the analytical laboratory at low enough detection limits to allow comparison to the established action levels. A goal of this QAPP is to provide sufficient planning and methodologies to prevent against either type of decision error.

4.2.7 DQO 1 – Step 7. Optimize the Design for Obtaining Data

The sampling and data collection programs are described in subsequent sections of this QAPP and associated FSP.

4.3 DQO 2 – EVALUATE THE NATURE AND LATERAL EXTENT OF SOIL CONTAMINATION IN THE RAILROAD RIGHT-OF-WAY ADJACENT TO RESIDENTIAL AREAS AT THE SITE

4.3.1 DQO 2 – Step 1. State the Problem

The previous sampling efforts in the railroad ROW at the Site were focused on screening the soil to determine if the soils exhibited elevated lead, arsenic, or cadmium in the soils. After the sampling was performed and elevated levels of lead, arsenic, and cadmium were found, a Site-wide human health risk assessment was completed. Through the risk assessment process, it was determined that lead and arsenic would be carried forward as the chemicals of concern for the Site. However, more detailed information is necessary to adequately characterize the nature and lateral extent of lead and arsenic soil contamination in the railroad ROW.

In an effort to address this need, additional sampling is required in portions of the railroad ROW located adjacent to residential areas to determine if remedial action is required in those specific segments of the railroad ROW. The railroad ROW segments are sampling units measuring 150 linear feet down a stretch of railroad ROW approximately 230 feet wide.

4.3.2 DQO 2 – Step 2. Identify the Decision

The decision to be made for each railroad ROW segment is: Does lead or arsenic contamination exist above ROD-established action levels in applicable soil samples for a specific railroad ROW segment.

4.3.3 DQO 2 – Step 3. Identify the Inputs to the Decision

The inputs to the decision include: Analytical results for arsenic and lead for applicable soil samples collected within each railroad ROW segment and ROD-identified action levels for arsenic and lead. Lead and arsenic concentrations will be determined by laboratory analysis using EPA Method 6010C. Analyses will be performed on composite samples collected from each railroad ROW segment from a single depth of 0 to 12 inches below ground surface.

4.3.4 DQO 2 – Step 4. Define the Study Boundaries

Spatial Boundaries

The lateral boundary for the investigation includes railroad ROW segments adjacent to residential areas with the Site. Railroad ROW segments are approximately 230 feet wide and 150 feet long. This includes approximately 3,800 linear feet of BNSF Railway ROW to the west of the former East Helena smelter site, 5,439 linear feet of BNSF Railway ROW to the east of the former smelter site, and two rail spurs west of the former smelter site – 3,200 linear feet of MTRL ROW and 500 linear feet of ASARCO ROW. Specific segments will be identified in the associated FSP.

Temporal Boundary

The temporal boundary of the sample is the single, one-time collection of that sample, as metals concentrations are not expected to vary seasonally.

4.3.5 DQO 2 – Step 5. Develop a Decision Rule

Decisions regarding the presence of soil contamination requiring remediation will be made on a per railroad ROW segment basis and will be based on comparison to action levels established in the ROD for the railroad ROW (1,000 ppm lead, 100 ppm arsenic). These comparisons will be made to determine whether soil contamination is present above action levels. Specific remedial actions for the railroad ROW segments will be determined based on these results.

4.3.6 DQO 2 – Step 6. Specify Acceptable Limits on Decision Errors

The potential for decision errors exists because all analytical measurements inherently contain sampling and measurement errors. Sampling design error occurs when the data collection scheme does not adequately address the inherent variability of the matrix being sampled. Measurement error occurs from the inherent variability in the collection, preparation, and analysis of an environmental sample. These errors will be minimized by following the procedures outlines in this QAPP, the associated FSP, and SOPs.

The null hypothesis is that the soil concentrations of lead and arsenic exceed ROD-established action levels in one or more railroad ROW segments. The alternate hypothesis is that soil concentrations do not exceed action levels in any railroad ROW segments.

There are two types of decision errors of concern for this QAPP:

1. False Acceptance: Deciding that a railroad ROW segment does require remedial action when in fact it does not.
2. False Rejection: Deciding that a railroad ROW segment does not require remedial action when in fact it does.

The majority of potential decision errors are typically associated with field sample variability and collection procedures. Analytical error is usually a much smaller portion of the total error associated with an environmental measurement; however the analytical data must be reported by the analytical laboratory at low enough detection limits to allow comparison to the established action levels. A goal of this QAPP is to provide sufficient planning and methodologies to prevent against either error.

4.3.7 DQO 2 – Step 7. Develop the Plan for Obtaining Data

The sampling and data collection programs are described in subsequent sections of this QAPP and associated FSP.

4.4 DQO 3 – EVALUATE THE EFFECTIVENESS OF REMEDIATION ACTIVITIES AT SELECT PREVIOUSLY REMEDIATED SITES

4.4.1 DQO 3 – Step 1. State the Problem

In order to maintain a protective remedy, it is necessary to evaluate the long-term effectiveness of remediation activities and assess whether recontamination is occurring. The previous Long-Term Monitoring program, amended in 2003 to include 30 properties and suspended in 2009, was implemented to monitor the effectiveness of the remediation activities in the East Helena Community. This program was originally implemented to maintain an effective procedure of sampling to identify and prevent recontamination of previously remediated properties, including residential sites, commercial properties, road aprons, parks, and a school. PWT has been directed by the EPA to restart the program, now titled the Long-Term Monitoring of Remediated Sites program, in order to collect additional soil data to ensure that recontamination of previously remediated properties does not occur.

4.4.2 DQO 3 – Step 2. Identify the Decision

The decision to be made is: Have the remediation activities in the East Helena Community been effective or has lead or arsenic in soil at previously remediated properties been reintroduced?

4.4.3 DQO 3 – Step 3. Identify Inputs to the Decision

The inputs to the decision include: Analytical results for arsenic and lead for applicable soil samples collected from each property and previous analytical results from the EPA's post-removal program from the same locations that can be used for comparisons to new data to monitor if increases in contamination are occurring. Lead and arsenic concentrations will be determined by laboratory analysis using EPA Method 6010C. Analyses will be performed on composite samples collected from each sampling unit at 0 to 1 inches below ground surface. This sampling depth was selected because any recontamination is expected to impact surface soil first.

4.4.4 DQO 3 – Step 4. Define the Study Boundaries

Spatial Boundaries

The lateral boundary for the LTMRS program includes the properties within and near the City of East Helena that have been chosen for monitoring. The vertical boundaries for the investigation are from the ground surface to one inch below ground surface.

Temporal Boundary

The temporal boundary of the sample is the repeated sampling of each property every third year to monitor the effectiveness of the remediation activities, as metals concentrations are not expected to vary seasonally.

4.4.5 DQO 3 – Step 5. Develop a Decision Rule

Soil data from each sampling unit at the sampled depth of 0 to 1 inch below ground surface will be compared to previously collected, post-removal soil data. When any sampling unit of a yard is found to have a soil lead or arsenic concentration that has increased (based on statistical significance as defined in the FSP) since the post-removal sampling program, further investigation by the EPA will be conducted to determine the source of the contamination and the need for additional remediation of that sampling unit.

4.4.6 DQO 3 – Step 6. Specify Acceptable Limits on Decision Error

The potential for decision errors exists because all analytical measurements inherently contain sampling and measurement errors. Sampling design error occurs when the data collection scheme does not adequately address the inherent variability of the matrix being sampled. Measurement error occurs from the inherent variability in the collection, preparation, and analysis of an environmental sample. These errors will be minimized by following the procedures outlines in this QAPP, the associated FSP, and SOPs.

The null hypothesis is that the soil in one or more sampling units of a previously remediated property exhibits significantly increased contamination when compared with previously collected post-removal levels. The alternate hypothesis is soil in any sampling units of a previously remediated property does not exhibit increased contamination when compared with previously collected post-removal levels

There are two types of decision errors of concern for this QAPP:

1. False Acceptance: Deciding that a sampling unit does require further investigation, including possible additional remedial action, when in fact it does not.
2. False Rejection: Deciding that a sampling unit does not require further investigation, including possible additional remedial action, when in fact it does.

The majority of potential decision errors are typically associated with field sample variability and collection procedures. Analytical error is usually a much smaller portion of the total error associated with an environmental measurement; however the analytical data must be reported by the analytical laboratory at low enough detection limits to allow comparison to the established action levels. A goal of this QAPP is to provide sufficient planning and methodologies to prevent against either error.

4.4.7 DQO 3 – Step 7. Optimize the Design for Obtaining Data

The sampling and data collection programs are described in subsequent sections of this QAPP and associated FSP.

4.5 PERFORMANCE CRITERIA

Soil data collected under this sampling program will be used to:

- Characterize the nature and vertical and lateral extent of lead and arsenic contamination in soil in the individual sampling units of the residential properties;
- Characterize the nature and lateral extent of lead and arsenic contamination in soil in the railroad ROW sampling segments; and
- Determine if individual sampling units within previously remediated properties included in the LTMRS have experienced increases in lead or arsenic levels as compared with post-removal levels.

This information will be used to aid in development of the RD. Table 2 identifies each parameter of interest (matrix), the analytical methods for soil and water (rinsate blank samples), the laboratory reporting limits for lead and arsenic, the action levels for lead and arsenic, , and the range of anticipated concentrations for lead and arsenic. The specific action levels from the ROD provide soil lead and arsenic concentrations for comparison purposes, enabling the EPA to make remedial decisions. Certain details of Table 2 are included in the associated FSPs.

4.6 DECISION ERRORS

As identified in the previous sections, for DQO 1 and DQO 2, there are two types of decision errors of concern for the soil sampling:

1. False Acceptance: Deciding that soil does require remedial action when in fact it does not.
2. False Rejection: Deciding soil does not require remedial action when in fact it does.

There are two types of decision errors of concern for the LTMRS program investigation (DQO 3):

1. False Acceptance: Deciding that a sampling unit does require further investigation, including possible additional remedial action, when in fact it does not.
2. False Rejection: Deciding that a sampling unit does not require further investigation, including possible additional remedial action, when in fact it does.

A goal of the soil sampling is to provide sufficient quantity and quality of lead and arsenic data to prevent against either error.

Further discussion regarding the sampling design, including technical rationale for the density and location of sampling locations, is presented in the activity-specific FSPs.

4.7 PRECISION

Precision is the reproducibility of measurements under a given set of conditions, representing random error. For large data sets, precision is expressed as the variability of a group of measurements compared to their average value (that is, the standard deviation). For duplicate or replicate measurements, precision is expressed as the relative percent difference (RPD) of a data pair and is calculated using the following equation (where A and B are the reported concentrations for duplicate sample analysis):

$$\mathrm{RPD} = \frac{|A - B|}{\frac{(A + B)}{2}} \times 100$$

Field precision will be assessed through the collection and analysis of field replicate soil samples.

Analytical laboratory precision will be assessed using the calculated RPD between laboratory standard spike data and investigative and associated matrix duplicate sample data (as appropriate). For laboratory analysis, the precision target between a soil sample and its paired replicate sample will be an RPD of 35 percent or less.

Laboratory precision will also be assessed for three or more replicated samples (for example, response factors for calibration standards).

4.8 BIAS (ACCURACY)

Accuracy is the degree of agreement of a measurement or an average of measurements with an accepted reference or "true" value, and is a measure of bias in the system. The accuracy of a measurement system is affected by errors introduced through the sampling process, field contamination, preservation, handling, sample matrix, sample preparation, and analytical techniques. Accuracy will be evaluated using the percent recovery calculated using the following equation:

$$\text{Percent Recovery} = \frac{|A - B|}{C} \times 100$$

Where:
A is the target analyte concentration determined analytically from the spiked sample
B is the background level determined by a separate analysis of the unspiked sample
C is the concentration of spike added

Although accuracy of the field program cannot be assessed quantitatively, the following criteria will be used for a qualitative accuracy assessment for this project: sample handling, shipping, preservation, and holding time.

Laboratory accuracy will be assessed quantitatively through the analysis of laboratory control and matrix spike (MS) samples and standard reference materials, and response factors for calibration standards and internal standard recoveries.

4.9 REPRESENTATIVENESS

Representativeness is a qualitative expression of the degree to which sample data accurately and precisely represent a characteristic of a population, a sampling point, or an environmental condition. Representativeness is maximized by ensuring that, for a given project, the number and location of sampling points and the sample collection and analysis techniques are appropriate for the specific investigation, and that the sampling and analysis program provides information that reflects "true" site conditions.

Representativeness of field data is dependent upon the proper design of the data collection procedures. The sampling and field measurement procedures to be used for the project data collection are based on existing site knowledge, the physical setting, past land use and operation, EPA guidance, and literature-reported methods. These procedures are described in this QAPP. Representativeness of the field data will be evaluated by assessing whether this QAPP was followed during sample collection. In addition, the analytical results from rinse blank samples and field duplicate or replicate samples will be used to evaluate the representativeness of field sampling procedures.

Laboratory data will be evaluated for representativeness by assessing whether the laboratory followed the specified analytical criteria in this QAPP and the standard operating procedures (SOPs), evaluating holding time criteria, and evaluating the results of method, instrument, rinse blank samples and field replicate or duplicate samples.

4.10 COMPLETENESS

Completeness is a measure of the amount of valid data obtained from an investigation compared to the amount expected under normal conditions. Completeness will be calculated using the following equation:

$$\text{Completeness} = \frac{\text{Number of valid data points}}{\text{Total number of measurements}} \times 100$$

Field data completeness is a quantitative measure of the actual number of samples collected and received by the laboratory in acceptable condition to be analyzed compared to the number of samples scheduled for collection. For this QAPP, the number of samples included in this completion calculation will include only those for which EPA obtains access. The field data completeness goal for this project is 95 percent.

Laboratory data completeness is a quantitative measure of the percentage of valid data for all analyses as determined by the precision, accuracy, and holding time criteria evaluation. Completeness will be calculated using the completeness equation by dividing the total number of valid data points by the total number of data points. The laboratory completeness goal for this project is 95 percent.

4.11 COMPARABILITY

Comparability is a qualitative parameter that expresses the confidence with which one data set may be compared to another. Comparability is dependent on similar QA objectives and is achieved through the use of standardized methods for sample collection and analysis, the use of standardized units of measure, normalizing results to standard conditions, and the use of standard and comprehensive reporting formats as defined by this QAPP.

Field data comparability is dependent on the use of similar and standard sampling methodology and the use of standard units of measure between different investigations at a site. For this investigation, field data will be collected using standard sampling and measurement procedures. Field data will be recorded in the field logbook and/or on the applicable field forms (i.e., sample forms or chain-of-custody forms). Comparability of field data will be evaluated by reviewing the field documentation to determine whether the field data collection procedures and sample collection, handling, and shipping protocols specified in this QAPP were followed.

Like field data, laboratory data comparability is dependent on the use of similar sampling and analytical methodology and standard units of measure between different investigations at a specific site. For this investigation, standard sampling and analytical methodologies that are similar to those used for previous sampling activities will be followed, to the extent possible. Laboratory data comparability will be assessed by determining whether the analytical methodologies presented in this QAPP and required by the CLP contract were followed.

4.12 METHOD SENSITIVITY

Sensitivity is an index of the ability of any analytical method or other detection procedure to make quantitative determinations at very low levels; laboratory data sensitivity and method sensitivity (detection limit). Laboratory data sensitivity is dependent on equipment maintenance, calibration, performance, and operator, as well as collection or extraction methods and sample handling. However, laboratories can usually provide lower detection limits with a higher degree of confidence as compared to field measurements, given the controlled environment for the equipment and technician.

Method sensitivity (detection limit) is the minimum concentration of an analyte that can be reliably distinguished from background “noise” for a specific analytical method. There are a number of detection limits for any given method: instrument detection limit, method detection limit (MDL), practical quantification limit, and the limit of quantification. Laboratories report their MDLs and provide qualifiers for certain results if the value is uncertain.

5.0 SAMPLING DESIGN

Detailed discussion regarding the RD soil sampling and LTMRS program soil sampling, including the general soil sampling approach, justification for the delineation of sampling units, location of sampling points within each sampling unit, number of samples collected, depth intervals from which samples are collected, contingencies for inaccessible sampling locations, and schedule and focus of sampling are presented in the activity-specific FSPs. PWT will prepare the activity-specific FSPs for the EPA's approval for activity-specific field events as needed.

5.1 SOURCES OF VARIABILITY

Small-scale matrix variability: Soils are complex and variable. Typically, sample collection errors are much greater than preparation, handling, analytical, and data analysis errors. Systematic errors (bias) may result from many sources, such as faults in sampling design, sampling procedure, analytical procedure, contamination, losses, etc. Soil heterogeneity and random errors in the measurement process also contribute to measurement variability. If biases and variability are too high, the data may not be suitable for meeting the project objectives.

Large-scale yard component variability: It is possible that a single property or railroad ROW segment may be characterized by many different soil conditions. Some areas may be wet or dry, other areas may be sandy or clayey, or tilled or untilled. Other portions may have gravel or areas dominated by outside fill materials, etc. Metal concentrations may be enriched or reduced in different portions of the property due to these different soil conditions and cover types.

6.0 FIELD SAMPLING ACTIVITIES

This section of the QAPP describes the field activities for conducting soil sampling for the properties and railroad ROW segments within the Site. EPA's *Contract Laboratory Program Guidance for Field Samplers* (USEPA 2010a) was consulted frequently during preparation of this QAPP and has been incorporated as applicable.

6.1 SAMPLING PROCEDURES

PWT will perform all sample collection procedures pursuant to the SOPs and the activity-specific FSPs. All PWT SOPs referenced in the QAPP and in the associated activity-specific FSP are provided in Appendix A of the QAPP and Appendix A of the FSP. Situations or issues not covered by the SOPs may occur in the course of a field investigation. In some cases, these situations can be anticipated for a particular site, and to the extent possible, they have been identified along with appropriate field team responses in the following sections. If unanticipated field conditions not covered by the SOPs or this QAPP are encountered, the field team will take action as necessary to remain safe, and contact the Project Manager for further instructions.

6.1.1 Split Samples

If a property owner requests, the opportunity to accept splits of the soil samples will be provided. It will not be possible to provide split soil samples following the laboratory drying or sieving processes to the property owner because volumes are expected to be limited. The property owner/representative will be required to remain on-site for the duration of the sampling from which splits are desired. The sampling crew will transfer the sample custody to the property owner. The property owner/representative will be asked to sign a chain-of-custody form for the relinquished samples. The owner representative will be responsible for providing and filling the sample container, and for preservation, storage, custody, shipping, and analysis of the sample from that point forward. Split samples collected for a property owner will not be considered in the remedial action design and thus QC comparisons outlined in Section 10.1 are not applicable to these samples.

6.1.2 Utilities

The potential for accidental damage to underground utilities is always present during any intrusive sampling activities. When utility hits occur, there can be negative impacts to residents or businesses due to service interruptions, in addition to the serious safety risk to site personnel. Prior to any intrusive work, underground utilities will be located in accordance with PWT's Utility Clearance SOP (PWT-ENSE-413). The PWT field team will ensure locates have been completed prior to starting the field work. Additionally overhead utilities may present a hazard to PWT Field Team members at any residential property. The presence of overhead utilities that may pose a hazard to the PWT Field Team will be assessed during the initial site walkthrough, prior to any sampling activities taking place.

6.1.3 Equipment, Supplies, and Containers

A list of field equipment and supplies necessary is provided as Table 3. The Field Team Leader will inspect all equipment prior to use. Unacceptable supplies will be returned to the supplier. Table 2 identifies sample containers and preservation requirements. Samples will be shipped to the assigned CLP laboratory.

6.1.4 Access Agreements

For all sampling activities, no sampling will occur until access agreements have been signed by the property owner or governing entity. New access agreements will be generated by PWT, in coordination with the EPA, to deliver to the property owner prior to sampling investigation on that property. Prior to mobilization, owners of properties needing to be sampled will be contacted. They will be informed of the upcoming sampling activities. An access agreement will be mailed or hand-delivered prior to sampling.

The PWT Team will also support the EPA's community outreach activities to inform the area residents and local officials of the sampling activities. Since this program is voluntary, properties without signed access agreements or areas otherwise deemed inaccessible (fenced properties with locked gates, areas with animals, wetland areas, areas beneath permanent or semi-permanent facilities, etc.) will not be sampled.

6.2 SAMPLE PACKAGING AND SHIPPING

After collection, samples of all media will be managed in accordance with PWT's Sample Handling SOP (PWT-ENSE-406), and the project-specific sampling handling requirements described below.

Samples will be packaged and shipped to the laboratory within 24 hours of sample collection. Samples will be maintained at 4°C ± 2°C during storage prior to transport. For samples that are shipped to the laboratory via a commercial carrier, the following procedures apply:

- Sample labels will be completed and attached to sample containers as described in Section 7.3.2.
- Sample containers will be placed in plastic resealable bags and placed in coolers.
- Ice or blue ice will be placed on top of and between sample bags in coolers. Enough ice or blue ice will be used so that the samples will be chilled and maintained at 4°C ± 2°C during transport to the laboratory.
- To prevent the sample containers from shifting inside the cooler, the remaining space in the cooler will be filled with inert cushioning material.
- The original copy of the completed chain-of-custody will be placed in a waterproof plastic bag and placed inside the cooler.
- The lid will be secured by wrapping strapping tape completely around the cooler in two locations
- Custody seals will be placed in two locations across the cooler closure to ensure that any tampering is detected. The date and initials of the sampler will be written on the custody seal.
- A copy of the signed chain-of-custody record and the completed waybill (shipping document) will be retained for the project files.

6.3 DECONTAMINATION

In general, field sampling equipment will either be properly disposed or decontaminated. Field decontamination of the hand tools used for excavating sample pits, as well as any other decontamination required, will be conducted and documented in accordance with procedures described in PWT's Personnel and Equipment Decontamination SOP (PWT-ENSE-424).

6.4 INVESTIGATION-DERIVED WASTE MANAGEMENT

IDW will be handled in accordance with PWT's Investigation Derived Waste Management SOP (PWT-ENSE-423*)*. IDW may consist of both solid and liquid waste streams. The solid waste stream may include used disposable soil sampling equipment, personal protective equipment, and excess sample volume. The liquid waste stream may include sampling equipment decontamination water.

Any excess soil sample volume generated during the soil sampling activities relating to this QAPP not being sent away for laboratory analysis will be replaced in the sample hole from which it was originally removed. PWT will limit the amount of decontamination water used by using disposable spoons and bowls when possible.

7.0 SAMPLE CHAIN-OF-CUSTODY/DOCUMENTATION

To ensure that samples are identified correctly and remain representative of the environment, careful sample documentation and custody procedures will be used during the sampling program to maintain and document sample integrity during collection, transportation, storage, and analysis. Field sampling personnel will be responsible for ensuring that proper documentation and custody procedures are initiated at the time of sample collection and maintained until custody of the samples is transferred to the laboratory or to a commercial freight carrier. The Project Manager is the Field Team Leader. Therefore, another qualified PWT Project Manager will be chosen to review and approve field documentation before it is finalized. The analytical laboratory will be responsible for maintaining sample custody and documentation in accordance with the procedures outlined in the QAPP, from the time the laboratory receives the samples until final sample disposition. Field documentation and sample chain-of-custody requirements are presented below.

7.1 FIELD LOGBOOK

Field logbooks will be bound notebooks or field survey books. All entries to field logbooks, and all other field documentation, will be made using indelible ink. Any errors will be corrected by drawing a single line through the incorrect entry, entering the correct information, and dating and initialing the change. Logbooks will be assigned to the project. After completion of the project, all field logbooks will be scanned and stored in the final project file.

The title page of each field logbook will contain the following:

- Name and address of PWT
- Logbook number
- Project name and location
- Project start/end date.

Daily information to be entered in the logbook may include the items listed below. However, information recorded on field forms is not required to be duplicated in the field logbook.

- The date
- Personnel on site (including visitors)
- Weather conditions
- Type(s) of field equipment used
- Field equipment calibration methods (if applicable)
- Approximate sample location and depth
- Date and time of sample collection
- Sample identification number
- Visual description of sampling location
- Sample type (e.g., field replicates)
- Photographic documentation of sample area (if applicable)
- Problems and corrective actions
- Any deviations from the QAPP/FSP
- Any other observations that may be relevant to the specific field program or activities that might affect the resulting analytical data.

7.2 PHOTOGRAPHS

Photographs may be taken during sampling activities, specifically a photograph of the property and any subsurface materials of note. Photographs will be numbered and documented in a photograph log which will include the following information: 1) photo number; 2) date; 3) sample location; and 4) description, including the following as applicable – direction, personnel, and equipment. Sample locations may be prepared for photographing using a scale (i.e., ruler) and sample location marker (i.e., label).

7.3 SAMPLE DOCUMENTATION

To minimize common problems such as labeling errors, chain-of-custody errors, transcription errors, or preservation failures, detailed procedures for properly recording sample information and analytical requests on chain-of-custody records, for preserving samples as appropriate, and for sample packaging and shipment are described below.

7.3.1 Sample Naming Convention

The sample name convention will vary for each different sampling activity. Where possible, the naming convention will be generally based on historical naming conventions to provide consistency for data management purposes. Specific naming conventions for each sampling activity (Residential Soil Sampling, Railroad ROW Soil Sampling, and LTMRS Soil Sampling) can be found in Section 2.2.5 of the respective activity-specific FSPs.

A unique CLP number will be assigned to each sample in addition to its sample identification as described in each activity-specific FSP. Both identifications will be recorded on the sample label in accordance with CLP requirements as identified in the *Contract Laboratory Program Guidance for Field Samplers* (USEPA 2010a).

7.3.2 Sample Labeling

Sample labeling will be completed in accordance with PWT's Sample Handling SOP (PWT-ENSE-406). Sample labels will be completed using water-proof ink and attached to the sample containers at the time each sample is collected. The following information will be included on the sample label:

- Company's name
- Sample identification and unique CLP number
- Date and time of sample collection
- Preservation
- Analyses to be performed
- Sample matrix
- Sampler's initials.

7.3.3 Sample Field Forms

Sample field forms will be completed for soil samples at each property or railroad ROW segment. Generic sample field forms for environmental sampling are attached to their respective sampling SOPs and are included in Appendix A for reference. Project- and activity-specific sample field forms are included as an appendix to each activity-specific FSP.

7.4 CHAIN-OF-CUSTODY RECORDS AND PROCEDURES

To ensure that samples are identified correctly and remain representative of the environment, careful sample documentation and custody procedures will be used to maintain and document sample integrity during collection, transportation, storage, and analysis.

7.4.1 Field Chain-of-Custody Procedures

Field sampling personnel will be responsible for ensuring that proper documentation and custody procedures are initiated at the time of sample collection and followed until custody of the samples is transferred to the laboratory or to a commercial freight carrier. Field sampling personnel will be required to become familiar with this QAPP and PWT's Sample Handling SOP (PWT-ENSE-406) prior to initiating field work. The analytical laboratories will be responsible for maintaining sample custody and documentation, in accordance with their CLP contract. The procedures outlined below generally describe this process from the time the analytical laboratory receives the samples until final sample disposition.

Chain-of-custody procedures provide an accurate written record of the possession of each sample from the time it is collected in the field through laboratory analysis. A sample is considered in custody if one of the following applies:

- It is in an authorized person's immediate possession
- It is in view of an authorized person after being in that person's physical possession
- It is in a secure area after having been in an authorized person's physical possession
- It is in a designated secure area, restricted to authorized personnel only.

All samples to be analyzed through the EPA Analytical Program will have a chain-of-custody record generated in the EPA SCRIBE database program, and will be signed by the field personnel prior to shipment. Signed shipping company waybills will serve as evidence of custody transfer between field personnel and the courier, and between the courier and the laboratory. Copies of the chain-of-custody record and the waybill will be retained and filed by field personnel prior to shipment. Multiple coolers may be sent to a laboratory in one shipment, with one chain-of-custody record. The outside of the coolers will be marked to show the number of coolers in the shipment. At a minimum, each chain-of-custody form will contain the following information:

- Sample identification and unique CLP sample number for each sample
- Date and time of sample collection
- Sample matrix (i.e., soil, water)
- Number and type of containers per sample
- Preservative (if applicable)
- Analyses to be performed
- Sampler's name and initials
- Release and acceptance information including date, location, and sampler's signature.

Unused portions of the chain-of-custody will be crossed out and initialed. The carrier will relinquish samples to the laboratory upon arrival, and the laboratory personnel will then complete the chain-of-custody.

7.4.2 Laboratory Chain-of-Custody Procedures

A signed chain-of-custody form will be completed by the laboratory custodian after the samples have been received and their condition checked. For samples shipped by commercial carrier, the waybill will serve as an extension of the chain-of-custody. File copies of the chains-of-custody and waybills will be retained.

Upon receipt in the laboratory, samples will be carefully checked to ensure that there are not any broken or leaking sample containers, proper preservation methods have been followed (including receipt at 4°C ± 2°C when applicable), and labels and custody seals are intact. Each chain-of-custody will be verified for accuracy and completeness, and any discrepancies will be brought to the attention of the EPA Analytical Program Manager. If there are no deficiencies or discrepancies identified, the sample chain-of-custody will be signed, and a copy will be returned to PWT along with the analytical case narrative. From the time of receipt, the laboratory will use its standard internal chain-of-custody procedures to ensure that the samples are appropriately tracked through completion of the analytical process.

If the samples and documentation are acceptable, each sample container will be assigned a unique laboratory identification number and entered into the laboratory's sample tracking system. Sample tracking will be documented in the laboratory information management system. Other information that will be recorded includes date and time of sampling, sample description, and required analytical tests.

When sample log-in has been completed, the samples will be transferred to limited-access temperature controlled storage areas. The sample storage areas (coolers, refrigerators) will be kept at 4°C ± 2°C and their temperatures will be recorded daily with thermometers calibrated against National Institute of Standards and Technology thermometers. Storage blanks will be used to assess the cleanliness of sample storage areas.

Sample custody will be maintained within the laboratory's secure facility until the samples are disposed. Laboratories will be instructed to hold or return to PWT the remaining sample quantities for the duration of the holding time or 6 months, whichever is shorter. The laboratory will be responsible for sample disposal, which will be conducted in accordance with all applicable local, state, and federal regulations. Disposal of all samples will be documented. The laboratory will maintain records in the project file.

7.4.3 Final Project Files Custody Procedures

The final project files for the soil sampling project data will be maintained and will be under the custody of the Project Manager in a secured area. At a minimum, the project file will contain relevant records including:

- Field logbooks
- Photographs
- Sample location drawings
- Original field sampling forms
- Laboratory data deliverables
- Data validation reports
- Data assessment reports
- Progress reports, QA reports, interim project reports
- Custody documentation (chain-of-custody forms, waybills).

7.5 CORRECTIONS TO DOCUMENTATION

All entries will be made using indelible ink. Any errors will be corrected by drawing a single line through the incorrect entry, entering the correct information, and initialling and dating the change.

8.0 LABORATORY ANALYTICAL METHODS

This section describes the analytical procedures that will be used for the acquisition of laboratory analytical data for the soil sampling program. Relevant aspects of field and laboratory procedures [(sample preparation and extraction procedures, instrumentation, MDLs, and method reporting limits (MRLs)] are also included or referenced. Analytical QC requirements, evaluation criteria, acceptance criteria, calibration procedures, preventive maintenance, and corrective actions are discussed in following sections. Only EPA CLP laboratories will be used for this project. This QAPP will be compared with CLP contract methods to ensure project requirements are met.

8.1 ANALYTICAL METHODOLOGY

The analytical methods and holding times necessary for sampling performed pursuant to this QAPP are presented in Table 2. All samples will be prepared and analyzed in accordance with the methods listed in Table 2 and in accordance with the laboratory's SOPs and CLP contract requirements.

8.2 METHOD DETECTION LIMITS AND METHOD REPORTING LIMITS

The MDL is an empirically derived value that is used to estimate the lowest concentration a method can detect in a matrix-free environment. The MDL is defined as the minimum concentration of a substance that can be measured and reported with 99 percent confidence that the analyte concentration is greater than zero. The MDLs are laboratory-dependent and are set by the CLP laboratory that is assigned.

More important than the MDL is the MRL. The MRL is the lowest concentration that can be reliably achieved within limits of precision and accuracy during routine operating conditions and is based on the MDL for each analyte. Like MDLs, MRLs are laboratory specific. For the EPA Analytical Program, the MRLs are identified as the contract required quantitation limits (CRQLs). The MRLs/CRQLs for the analytical methods included in this QAPP are presented in Table 2 and must be met by the laboratory. The laboratory's lowest calibration standard concentration will be at or below the MRL/CRQL for each target analyte.

In order to support remedial design decisions, it is important that the MRLs/CRQLs for lead and arsenic are below the action limits established in the ROD and noted on Table 2. The EPA's Analytical Program has confirmed their ability to achieve the required MRL/CRQL for lead and arsenic.

8.3 REPORTING REQUIREMENTS

The MRLs/CRQLs for lead and arsenic are below the action limits established in the ROD. Non detections in method blanks will be reported as less than the MDL (<MDL). For all other samples the following will apply:

- Target analyte non-detections will be reported (at a minimum) as less than the MRL/CRQL
- If target analytes are detected at or above the MRL/CRQL, they will be reported as results with possible qualifiers.

The EPA Analytical Program Manager will be notified immediately regarding the failure of target analytes to meet MRLs/CRQLs to assess potential corrective action. The decision to implement corrective action will be based on whether there are any analytical alternatives or clean-up steps that would improve the detection limits and whether the elevated detection limits will adversely affect data use. Any data that do not meet the MRLs/CRQLs due to sample dilution will be included in the case narrative, and the supporting documentation will be included in the data packages.

9.0 QUALITY CONTROL

The QC samples that will be used to evaluate analytical data are described in conjunction with the quality parameters to which they pertain in Sections 4.6 through 4.11. These include QC samples prepared both in the field and by the laboratory. Method-specific QC procedures are detailed in the respective method SOP. Frequency of QC sample analysis, acceptance criteria (control limits), and corrective actions are discussed below. The following paragraphs also describe the QC samples and holding time criteria that will be used to assess data quality.

9.1 FIELD PROGRAM

For field sampling, QC samples are used to assess sample collection techniques and to assess environmental conditions during sample collection and transport. For this project, field QC samples will include replicate or co-located soil samples, MS soil samples, equipment rinse blanks, and temperature blanks. The replicate and MS soil samples and equipment rinse blanks are identified in Table 2. The number of equipment rinse blank samples is typically a function of the number of days of sampling rather than the number of investigative samples; therefore, an approximate tally of these QC samples is included on Table 2. Field blank samples are not proposed to be collected as part of this investigation because ambient conditions at the site are not expected to contain high concentrations of lead or arsenic that are likely to contaminate the investigative samples; this is consistent with the *Contract Laboratory Program Guidance for Field Samplers* (USEPA 2010a). Trip blank samples will not be used in sampling activities pursuant to this QAPP, since the only type of analytical method being proposed is for analysis of metals.

Replicate Soil Samples: Soil replicate samples will be used to assess variability in the sample medium and to assess sampling and analytical precision. A replicate sample pair is a single grab or composite sample that is split into two samples during collection. If the sample is a composite, the material will be thoroughly homogenized before it is split into the investigative and replicate samples. For each replicate sample pair, one of the samples is labeled with the investigative sample identification and the other is labeled with the replicate sample identification in accordance with the naming convention described in Section 2.2.5 of the activity-specific FSPs. This sample pair is then submitted to the same laboratory and analysed as two separate samples.

Precision will be evaluated by calculating the RPD between the field replicate samples. For field replicate pairs whose measured values are both greater than the MRL. The RPD is expected to be less than 35 percent for replicate soil sample pairs, with RPD higher than 35 percent indicating a high level of heterogeneity in the solid matrix. If highly variable soils are encountered, as evidenced by RPDs consistently above 35 percent, then the sample frequency in the following sampling event may be increased to ensure that representative data are collected. The frequency for replicate samples will be one per 20 investigative samples.

Equipment Rinse Blanks. Equipment rinse blanks will be used to evaluate the effectiveness of field decontamination procedures. Rinse blanks are clean, deionized, metals-free water samples that are exposed to sampling procedures (i.e. exposed to decontaminated sampling equipment in a manner consistent with how investigative sample media contact the equipment), and transported back to the laboratory for analysis. Rinse blanks will be analyzed for the same metals as the field samples. Rinse blanks will be collected at a frequency of one per day on days when field sampling equipment is decontaminated for reuse.

Temperature Blanks. A temperature blank is used to monitor temperature preservation of samples transported to the analytical laboratory. The temperature blank is distilled water stored in a glass/plastic vial or jar. A temperature blank must be included with each sample cooler submitted for analysis. Upon receipt by the analytical laboratory, the sample custodian will measure and record the temperature of the blank sample. The temperature blank must be within the project criteria of 4°C ± 2°C.

9.2 LABORATORY PROGRAM

The general objectives of the internal CLP laboratory QC program are to:

- Ensure that procedures are documented, including any changes in administrative or technical procedures
- Ensure that analytical procedures are validated and conducted according to method guidelines and CLP laboratory SOPs
- Monitor the performance of the laboratory using a systematic inspection program
- Ensure that data are properly reported and archived
- A complete description of the CLP can be found at: http://www.epa.gov/superfund/programs/clp/index.htm, including the EPA's QA program. The CLP specifies analytical methods, laboratory equipment maintenance and calibration, analytical precision and accuracy, QC requirements, data management, and documentation.

Laboratory QC consists of two distinct components, a laboratory component and a matrix component. The laboratory component measures the performance of the laboratory analytical process during sample analyses, while the matrix component measures the effects of a specific medium on the method performance. The QC samples that will be used to assess the laboratory component and the media component of analysis are described the following paragraphs. Corrective actions for instrument calibrations or QC sample data out of compliance are described in the laboratory-specific QA/QC program, which can be found at: http://epa.gov/superfund/programs/clp/ism1.htm.

The EPA assigned CLP laboratory will conduct internal QC checks for analytical methods in accordance with their SOPs, the individual method requirements, and this QAPP. The laboratory, through the EPA Analytical Program Manager, will notify the Project Manager or Project Chemist in writing before making significant changes resulting from corrective actions to procedures described in this QAPP, or to the laboratory standard analytical methodology.

The laboratory will, at a minimum, analyze internal QC samples at the frequency specified by the CLP *Statement of Work for Inorganic Superfund Methods*, Exhibit D, Part A (Analytical Methods for ICP-AES) and internal SOPs. Method-specific QC procedures, frequency of QC sample analysis, acceptance criteria (control limits), and corrective actions will be identified in the SOPs provided by the EPA's contracted analytical laboratories, and will be in accordance with industry standards. The following paragraphs discuss holding times and the QC samples that the laboratory will use to assess data quality.

Sample Holding Time. Sample holding time refers to the length of time that a sample or sample extract remains representative of environmental conditions. The holding time for the metals analyses in soil is six months. The holding time for the metals analysis in water is 14 days. It is not anticipated that any samples will miss their holding time for this project. No samples will be analyzed outside of the specified method holding times without approval by the Project Chemist. Following sample analysis, any remaining sample material for all samples (100 percent) will be archived by the laboratory through the duration of the holding time. The holding times for each analytical method are detailed in Table 2.

Method Blanks. Method blanks will be used to monitor the laboratory preparation and analytical systems for interferences and contamination from glassware, reagents, sample manipulations, and the general laboratory environment. The method blank is an analyte-free matrix (reagent grade water or laboratory grade sand) to which all reagents will be added in the same volumes or proportions as used in sample processing and will be taken through the entire sample preparation/extraction and analytical process.

Method blanks will be analyzed at the frequency specified by the CLP method and in the laboratory QA program SOPs.

Matrix Spikes and Matrix Spike Duplicates. MS/matrix spike duplicates (MSD) measure matrix-specific method performance and will be used to assess accuracy. MS/MSD samples will be used to assess the influence of the sample media (media interference) on the analysis. Samples for MS/MSD analysis will be site-specific and analyzed at a frequency of five percent of the total number of samples for all analyses. Sampling personnel will collect additional sample volumes and indicate on the chain-of-custody form that the additional sample material is to be used for the MS/MSD. Each MS/MSD sample will be spiked with the compounds specified by CLP protocol. The laboratory will analyze a MS and a post-digestion spike as required by CLP protocol. Percent recoveries of target analytes from the spiked sample should be within prescribed control limits specified in the EPA contract QC section. Investigative sample results associated with spiked sample results that are not within control limits will be flagged and a post-digestion spike will be performed.

9.3 LABORATORY BATCH QUALITY CONTROL LOGIC

The frequency of instrument calibration and QC sample analysis for the analytical methods are batch controlled. Site sample data for this project will be associated with sample batch QC samples that were extracted concurrently with the site samples and analyzed in the same analytical batch (sequenced on the same instrument relative to the primary sample results).

For this project, a sample batch is a group of 20 or fewer environmental samples of the same matrix that are extracted within the same time period (concurrently) or in limited continuous sequential time periods. Samples in each batch are of similar matrix (e.g., soil), are treated in a similar manner, and the same reagents are used for each sample batch. Samples and their associated QC samples (method blank and MS) will be prepared in a continuous process. The sample batch will be analyzed sequentially on a single instrument. All preparation and analyses requirements from the EPA Analytical Program contracts will be followed.

10.0 CALIBRATION, TESTING, INSPECTION, AND MAINTENANCE OF EQUIPMENT, INSTRUMENTATION AND SUPPLIES

10.1 CALIBRATION

Calibration refers to the process of verifying, adjusting, or fine-tuning the investigative measurements produced by a given instrument to agree with known values. In general, the calibration process involves analyzing commercially prepared calibration standards of known concentrations or values which span either the measurement range of the instrument or the range of values anticipated to be encountered in a given investigation. The measured value produced by the instrument is then compared to the published value for that calibration standard, and the difference is compared to project, method, or instrument acceptance criteria. If the difference between the published and measured values for the calibration standard is smaller than the acceptance criteria, then the instrument is considered to be in calibration. If the difference is greater than the applicable acceptance criteria, the instrument is considered to be out of calibration, and must be recalibrated in accordance with applicable SOP and the manufacturer's instructions before any valid measurements may be made with the device. Field and laboratory equipment calibration procedures and requirements are described in the following sections.

10.2 FIELD EQUIPMENT CALIBRATION

PWT does not anticipate the use of any field equipment that requires calibration for the sampling efforts associated with this QAPP. If this changes, PWT will calibrate according to the manufacturer's recommendations and specifications and amend the QAPP accordingly.

10.3 LABORATORY INSTRUMENT CALIBRATION

Laboratory instrument calibration is necessary to ensure that the analytical system is operating correctly and functioning at the proper sensitivity to meet the CRQLs. Calibration establishes the dynamic range of an instrument, establishes response factors to be used for quantitation, and demonstrates instrument sensitivity. Criteria for calibration are specific to the instrument and the analytical method. An EPA CLP laboratory will be assigned to perform analyses for this sampling program. The following describes standard practices for laboratory calibration that are followed by CLP laboratories.

10.3.1 Calibration Standard Preparation

All instruments will be calibrated in accordance with the analytical method and the laboratory SOPs. To ensure the highest quality standard, primary reference standards will be used by the laboratory and will be obtained from the laboratory or other reliable commercial sources. When standards are received at the laboratory, the date received, supplier, lot number, purity, concentration, and expiration date will be recorded in a standard logbook. Vendor certificates for the standards will be retained in the files and made available upon request.

Standards will be obtained in their pure form or in a stock or working standard solution. Dilutions will be made from the vendor standards. Records regarding standards will clearly trace their preparation, use in calibration, expiration dates, and quantitation of sample results. Standards will be given a standard identification number, and the following information will be recorded in the standards logbook:

- Source of standard
- Initial concentration of the standards
- Final concentration of the standard
- Volume of the standard that was diluted
- The solvent and the source and lot number of the solvent used for standard preparation
- Expiration date of the standard
- Preparer's initials.

All standards will be verified prior to use.

After preparation and before routine use, the identity and concentration of the standards will be verified. Verification procedures include a check for chromatographic purity (if applicable) and verification of the standard's concentration by comparing its response to a standard of the same analyte prepared or obtained from a different source. Standards will be routinely checked for signs of deterioration (e.g., discoloration, formation of precipitates, and changes in concentrations), and will be discarded if deterioration is suspected or the expiration date has passed. Expiration dates may be taken from the vendor recommendation, the analytical methods, or from internal research.

10.3.2 Instrument Calibration

Criteria for calibration are specific to the instrument and the CLP analytical method. Each instrument will be calibrated according to the manufacturer's guidelines using standard solutions appropriate to the type of instrument and the linear range established for the analytical method. The instrument calibration will be from the lowest to the highest calibration standard and the lowest calibration standard concentration will be at or below the CRQL for each target analyte.

Instrument calibration information will be documented and, at a minimum, include the equipment calibrated, the reference standards used for calibration, the calibration techniques, actions, acceptable performance tolerances, frequency of calibration, and calibration documentation format. The laboratory will maintain records of standard preparation and instrument calibration. Calibration records will include checks once every twenty samples using standards prepared independently of the calibration standards, and instrument response will be evaluated against established criteria. The analysis logbook, maintained for each analytical instrument, will include, at a minimum, the date and time of calibration, the initials of the person performing the calibration, and the calibration reference number and concentration. Instruments will be calibrated in accordance with the criteria specified by the applicable analytical method. CLP Method SOPs are specified for each analytical laboratory.

10.4 EQUIPMENT TESTING, INSPECTION, AND MAINTENANCE

A preventive maintenance program is necessary to promote the timely and effective completion of a measurement effort for either field or laboratory programs. The preventive maintenance program will be designed to minimize the downtime of crucial sampling or analytical equipment due to unexpected component failure. In implementing this program, efforts will be focused on establishment of maintenance responsibilities, establishment of maintenance schedules for major or critical instrumentation and apparatus, and establishment of an adequate inventory of critical spare parts and equipment.

10.4.1 Field Equipment/Instruments

PWT does not anticipate the use of any field equipment or instruments that require testing, inspection, or maintenance for the sampling efforts associated with this QAPP. If this changes, PWT will test, inspect and maintain the equipment according to the manufacturer's recommendations and specifications and amend the QAPP accordingly. Sample containers (Table 2) will be purchased from a certified supplier of environmental sampling containers. Other field supplies that may be used by the PWT field team such as gloves, trowels, paper towels, spray bottles, etc., are listed in Table 3.

10.4.2 Laboratory Equipment

Preventive maintenance of laboratory equipment and instruments is essential to ensure the quality of the analytical data produced. The objective of preventive maintenance is to ensure instrument operation is appropriate for both project and method DQOs. The laboratory will have a routine preventive maintenance program to minimize the occurrence of instrument failure or other system malfunctions. Designated individuals will be responsible for routine scheduled maintenance for each instrument system and required support activity. The following paragraphs focus on maintenance responsibilities, maintenance schedules, record keeping, and inventory of spare parts and equipment.

For this sampling program, PWT will utilize EPA CLP laboratories for all analytical services. The CLP Laboratory will be assigned by the EPA Analytical Services Coordinator. A complete description of the EPA Analytical Program can be found at: http://www.epa.gov/superfund/programs/clp/index.htm. All CLP laboratories follow the same QA/QC program. The statement of work for the CLP's Inorganic analytical method, ISM01.3, which will be utilized for this project, can be found at: http://epa.gov/superfund/programs/clp/ism1.htm. These statement of work documents constitute the technical and contractual framework for commercial environmental testing laboratories to apply analytical methods for the isolation, detection and quantitative measurement of environmental samples. This includes a summary of requirements, reporting and deliverable requirements, a target compound list and contract required quantitation limits, analytical methods, quality assurance/quality control requirements, chain-of-custody, document control, and SOPs, a glossary of terms, and a data dictionary and format for data deliverables in computer-readable format. Laboratory equipment testing, inspection, and maintenance, and the associated documentation requirements will be in accordance with the contract between the assigned laboratory and the EPA, and the QA/QC program for the EPA Analytical Program. Adherence to these contract requirements is monitored by the EPA Analytical Services Coordinator.

Maintenance Responsibilities
Maintenance responsibilities for laboratory equipment will be assigned to designated personnel. These individuals will establish maintenance procedures and schedules for each major equipment item. The instrument manufacturer will perform instrument maintenance and repair, as scheduled or needed. The analysts will perform other routine preventive maintenance tasks. Only qualified individuals will perform maintenance activities.

Maintenance Schedules
Maintenance schedules are based on the manufacturer's recommendations or sample load. Maintenance activities for each instrument will be documented in a maintenance logbook, as described below.

Record Keeping
Maintenance will be documented in instrument-specific bound logbooks, which will be kept with the instrument. The date, initials of the individual performing the maintenance, and the type of maintenance will be recorded in this logbook. Receipts for routine maintenance performed by the manufacturers' representatives will be filed in the appropriate laboratory department. This logbook serves as a permanent record, which documents routine preventive maintenance, as well as any service by external individuals such as manufacturers' service representatives.

In addition, all receipts from routine maintenance by manufacturers' representatives will be maintained in the laboratory's file. These records will be made available upon request during internal or external audits.

Spare Parts
An adequate inventory of spare parts will be maintained to minimize equipment down time. This inventory will include those parts (and supplies) that are subject to frequent failure, have limited useful lifetimes, or cannot be obtained in a timely manner if failure occurs.

Laboratory Contingency Plan
In the event of instrument failure, every effort will be made to analyze samples by an equivalent alternate means within holding times. If the redundancy in equivalent instrumentation is insufficient to handle the affected samples, the EPA Laboratory Program Manager will be notified and will contact the PWT Team if samples need to be redistributed within the CLP network.

10.5 INSPECTION/ACCEPTANCE OF SUPPLIES AND CONSUMABLES

The Field Team Leader shall be responsible for ensuring that all required field equipment and supplies are available, for performing routine field supply inventory tracking, and for ordering, receiving, inspecting and storing additional supplies when necessary. The Field Team Leader will inspect deliveries to ensure that the materials received match the item ordered, and are in acceptable condition at the time of receipt.

11.0 NON-DIRECT MEASUREMENTS

The proposed OU2 residential soil sampling and railroad right-of-way soil sampling programs do not include the use of any non-direct measurements. Examples of non-direct measurements include the use of data from computer databases or literature files, or models that are accessed and used. It is focused on the collection and analysis of specific environmental samples to aid in the remedial design.

The proposed OU2 LTMRS soil sampling program includes the use of historical analytical data. This historical analytical data, collected under EPA approved SAPs, will be compared to current analytical results gathered for arsenic and lead for soil samples collected from the Long-Term Monitoring program properties. This comparison will not drive any remedial decisions, but instead will be used to qualitatively evaluate this removal program and determine whether recontamination of previously remediated properties has occurred.

12.0 ASSESSMENTS AND RESPONSE ACTIONS

Independent technical systems and performance audits of field and laboratory activities may be conducted to assess whether sampling and analysis protocols conform to the criteria specified in this QAPP. The systems audit is a qualitative review of the overall sampling or measurement system, while the performance audit is a quantitative assessment of the measurement system, and includes both internal and external audits. These audits will be used to assess whether the resulting data meet the project-specific DQOs, to assess whether the data comply with QC criteria, and to identify the need for preventive or corrective action. Definitive data validation is also a quantitative check of the analytical process, where documentation and calculations are evaluated and verified. Data verification and validation procedures are discussed in Section 13.4 of this QAPP. The EPA Region 8 will implement their QA/QC program and may perform field or laboratory audits, at their discretion. PWT will not perform laboratory audits under this program.

It is anticipated that one assessment of field activities and procedures will be conducted during the 2014 field investigation activities. If warranted by the findings of the first audit, and if the duration of field activities permits, a follow-up audit may be conducted in 2014 or 2015.

12.1 FIELD PERFORMANCE AND SYSTEM AUDITS

Oversight of field sampling is the direct responsibility of the PWT Project Manager, who will review elements of the project-specific work plan and this QAPP to ensure that the objectives of the project are met. In addition to an initial review, the sampling procedures will be reviewed as the fieldwork progresses so that any necessary modifications are made in a timely manner.

PWT's QAO, or her designee, may conduct internal audits of field activities to assess the performance and effectiveness of the existing quality management system in accordance with this QAPP. The intent of these audits is to identify, correct, and prevent problems that hinder the achievement of the project data DQOs. If the auditor determines during an assessment that non-conformances are occurring which will seriously impact the usability of the data being collected, the auditor has the authority to stop work until the issues are resolved. If the QAO issues a stop-work order to the field sampling team, the Project Manager will be notified immediately so that the deficiencies may be resolved and work can recommence.

The audits may include examining field sampling records, log books and field sampling forms; observing field sample collection, handling, storage, and transportation procedures, including organization and minimization of potential contamination sources; and reviewing chain-of-custody records and procedures.

After an internal audit is completed, a debriefing session will be held for participants to discuss the preliminary audit results. The auditor will prepare an audit evaluation report that includes observations of the deficiencies and the necessary recommendations for corrective actions. A draft audit evaluation report will be provided to the Project Manager and the RAC2 Program Manager within 10 days after the field or system performance audit is completed, and will be finalized no later than 30 days after the audit was performed. Conformance with the specifications presented in the manufacturer's SOPs, PWT's SOPs, this QAPP, and the relevant activity-specific FSP will be noted, and non-conformances or deviations will be addressed through corrective or preventive actions identified by the QAO and the project team, implemented by the Project Manager, and approved by the QAO and the RAC2 Program Manager. Upon request, the audit evaluation report and any associated proposed corrective or preventive actions will be forwarded to the RPM along with a time frame for implementation of corrective actions. If appropriate, and the duration of field activities permits, follow-up audits will be performed prior to completion of the project to ensure corrective actions have been implemented appropriately and completely by the field team.

External field audits may be conducted by EPA Region 8. Field audits may be conducted at any time during the field operations and will be based upon the information presented in PWT's SOPs and/or the manufacturer's SOPs, this QAPP, and the relevant activity-specific FSP. The audits may or may not be announced, at the discretion of the auditing agency.

12.2 LABORATORY PERFORMANCE AND SYSTEM AUDITS

In-house and regulatory agency audits of laboratory systems and performance will be a regular part of the laboratory's QA program. Routine audits will be conducted by the Laboratory's QAO or designee, and consist of a review of the entire laboratory system and, at a minimum, include examination of sample receiving, log-in, storage, and chain-of-custody documentation procedures, sample preparation and analysis, and instrument procedures.

To verify proper implementation of laboratory procedures and adherence to this QAPP, the EPA Region 8 may perform an external audit prior to or during this project. These audits may or may not be announced and will be conducted at the discretion of the auditing agency. External audits may include (but not be limited to) review of laboratory analytical procedures, laboratory on-site audits, or submission of performance evaluation samples to the laboratory for analysis. If conducted, the laboratory audit will typically include a review of the following items:

- Sample custody procedures
- Sample disposal procedures and documentation
- Calibration procedures and documentation
- Completeness of data forms, notebooks, and other reporting requirements
- Data review and validation procedures
- Data reporting integrity and archiving
- Data storage, filing, and record keeping procedures
- QC procedures, tolerances, and documentation
- Operating conditions of facilities and equipment
- Documentation of training and maintenance activities
- Systems and operations overview
- Security of laboratory automated systems.

Deficiencies and corrective action procedures will be clearly documented in the audit report.

12.3 REPORTING

The Field Team Leader is the same person as the Project Manager. Therefore, the Field Team Leader will prepare field reports for every separate field event and submit them an alternate PWT Project Manager familiar with the Site for review and approval. After they are reviewed and approved, the field reports will be managed in the project file. The field reports will be submitted to the alternate PWT Project Manager in a timely fashion, and will include, at a minimum, the following information:

- A list of all samples collected during the previous week
- Description of any deviations from the SOPs, including the reason for the deviation and the resolution
- Description of any deviations from this QAPP, including the reason for the deviation and the resolution
- Description of any deviations from the activity-specific FSP, including the reason for the deviation and the resolution
- Additional information relating to or having a significant impact on project quality or productivity, such as severe weather, staffing changes, or similar.

Regardless of the length of the field activities, the Field Team Leader will compile the field reports from each separate event and include them in the final sampling report. The final sampling report will include the above information for the entire duration of the field activities.

In addition, a Data Summary and Evaluation Report will be prepared upon completion of each sampling event conducted pursuant to the activity-specific FSPs. These reports will summarize all of the data analysis and sampling locations, including a data verification and validation summary, address the data quality and whether the data is valid for use in the remedial design, and include an analysis of the laboratory data. The reports will be formatted according to each sampling event. For example, residential samples will be reported for each property in a format that may be presented to the property owner. The railroad ROW sampling events will be summarized in a single report for each separate railroad owner.

13.0 DATA MANAGEMENT

A stand alone data management plan has not been prepared for the soil sampling program. Instead, data reduction, reporting, validation, and management procedures are presented in detail below.

13.1 DATA REDUCTION

13.1.1 Field Data Reduction

Field data will be used as reported from the field notes, field sampling forms, and chain-of-custody records. Sampling unit areas will be measured and tabulated in the field, noted on the field notes and sampling forms, and entered into the geographic information system (GIS) database for use during the RD decision making process. No further reduction of field data will be required.

13.1.2 Laboratory Data Reduction

The laboratory will reduce all analytical data in accordance with the analytical methods, the laboratory SOPs and the CLP protocols. Section 4.0 of this QAPP provides equations that will be used to assess precision and accuracy.

13.2 DATA REVIEW

The CLP laboratory will review in-house data under the direction of the Laboratory Project Manager or the Laboratory QAO. The laboratory will prepare and retain full analytical and QC documentation. Both screening and definitive data will be reviewed prior to release by the laboratory. In general, the laboratory data review will be conducted as described in the following paragraphs.

The bench analyst will conduct the initial data review based on established protocols specified in the laboratory SOPs, analytical method protocol, and project-specific DQOs. At a minimum, this review will include the following:

- An assessment of sample preparation and analysis procedures and documentation for accuracy and completeness
- Assessments of whether the appropriate SOPs have been followed
- An assessment of analytical results for accuracy and completeness
- An assessment of whether QC samples are within established control limits and method blank data are acceptable
- An assessment of whether documentation is complete (that is, all anomalies in the preparation and analysis have been documented, out-of-control forms, if required, are complete, and holding times are documented).

The calculations used to evaluate precision and accuracy are defined in Section 4.0 of this QAPP, along with the acceptance criteria for calibration, precision, and accuracy assessment.

When an analysis of a QC sample (blank, spike, duplicate/replicate, or similar) indicates that the analysis of that batch of samples is not in control, the analyst will immediately bring the matter to the attention of the appropriate designated QC staff (QAO, Project Manager, Project Chemist) and the EPA Laboratory Program Manager. These individuals will determine whether the analysis can proceed, or if selected samples should be reanalyzed, or if specific corrective action needs to be taken before analyzing additional samples. Out-of-control analyses and information justifying accuracy or precision outside acceptance criteria must be documented. A non-conformance report will be prepared for laboratory analysis out-of-control events that require documentation. PWT will be notified by the EPA Laboratory Program Manager as possible to determine appropriate corrective action for out-of-control events resulting in unacceptable data. Non-conformance report forms and out-of control analyses forms are specific to each laboratory, and meet the requirements of their EPA contract.

After this review is complete, the analyst will sign the applicable control documentation associated with the analytical batch and forward to the appropriate reviewer. This reviewer (department manager or QAO) will be responsible for review and approval of the analytical control documentation associated with each analytical batch, as well as any corrective action explanations provided by the analyst. This individual will also be responsible for determining whether the analytical data meet QC criteria established by the analytical methods and by this QAPP, and for identifying QC problems that require further resolution. A permanent record of any corrective actions will be maintained in the laboratory files.

The Laboratory Project Manager will provide the final review and approval of the analytical data that have been approved by the analyst and other designated reviewer. The Laboratory Project Manager will also be responsible for reviewing final data reports for proper format and reporting consistency prior to releasing the reports to PWT. This review will include the following at a minimum:

- Laboratory name and address
- Sample information (includes unique sample identification, sample collection date and time, date of sample receipt, and date(s) of sample preparation and analysis)
- Analytical results, reported with an appropriate number of significant figures
- Reporting limits reflecting dilutions, interferences, and corrections for dry weight as applicable
- Method references
- Appropriate QC results and correlations for sample batch traceability and documentation
- Data qualifiers with appropriate references and narrative on the quality of results
- Confirmation that project-specific requirements have been met.

The Laboratory Project Manager or the Laboratory QAO will also be responsible for qualifying any data that may be unreliable. Data qualifications will be based on the laboratory SOPs, the analytical method, and the principles outlined in the *U.S. EPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review* (USEPA 2010b).

13.3 DATA REPORTING

Laboratory data will be reported to PWT as electronic data deliverables (EDDs) and presented in a format that will facilitate data input, review, and evaluation. For CLP laboratories, this format will be as specified under the EPA's Analytical Program. Both field and laboratory analytical data will be input into SCRIBE for the EPA retention and use, standard Microsoft software will be used throughout the data management and reporting activities. Mapping activities and/or evaluations will be conducted using ESRI ArcView software. The analytical data will be reported in a format organized to facilitate data validation. A PWT Database Manager, who may be the PWT Project Manager or other qualified PWT Team technical staff, will import sample locations and laboratory analytical data into the master project database, which also contains the historical sampling results from the Site. The Database Manager will maintain the database and provide the data to the project team, as needed, for planning future sampling tasks, developing the remedial design, and developing and updating a searchable GIS map displaying current property statuses at the Site.

13.4 DATA VERIFICATION AND VALIDATION

As described in Section 3.0 of this QAPP, the validity of the field and analytical data will be evaluated using quantitative and qualitative statements that describe data quality. For this project, full validation will be conducted on a minimum of 10 percent of the investigative samples. Data verification will be completed on all other analytical data. Data validation/verifications will be performed by the Project Chemist in accordance with the *U.S. EPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review* (USEPA 2010b) and the *Guidance for Labelling Externally Validated Laboratory Analytical Data for Superfund Use* (USEPA 2009b). PWT does not utilize a data validation software package.

Full validation will be performed on at least 10 percent of the laboratory analytical results for lead and arsenic to ensure that data were produced in accordance with procedures outlined in the QAPP. The following elements will be reviewed for conformance as part of the full data validation:

- Methodology
- Holding times
- Calibration
- Blanks
- Spikes
- Duplicates/Replicates
- Practical quantitation limits
- Analyte identification
- Analyte quantification

Data validation techniques include accepting, rejecting, or qualifying the data on the basis of acceptance criteria defined in this QAPP.

Data verification will be completed on the remaining approximately 90 percent of laboratory analytical results. Data verification simply involves comparing the hard-copy laboratory report to the data in SCRIBE for completeness and accuracy.

The results of the data verification/validation will be documented in a data verification/validation report, and will be appended to the associated data summary report. After the data verification/validation report is complete, it will be submitted to the PWT Project Manager. The Project Chemist will present any significant findings or limitations on data usability to the Project Manager. Data will not be released for use prior to completion of the data verification/validation process.

13.5 DATA USABILITY

After environmental data have been reviewed, verified, and validated the data must be evaluated to determine whether project quality objectives have been met. To the extent possible, the EPA's data quality assessment process will be followed to verify that the type, quality, and quantity of data collected are appropriate for their intended use as outlined in the *Data Quality Assessment: A Reviewer's Guide* (USEPA 2006b) and in the companion guidance, *Data Quality Assessment: Statistical Methods for Practitioners* (USEPA 2006c). The assessment process includes five steps: (1) review the project's objectives and sampling design; (2) conduct a preliminary data review; (3) select the statistical test; (4) verify the assumptions of the statistical method; and (5) draw conclusions from the data.

When the five-step assessment process is not completely followed because the data objectives are qualitative in nature, data quality and data usability will be assessed systematically including:

- A review of the sampling design and sampling methods to verify that these were implemented as planned and are adequate to support project objectives
- A review of project-specific data quality indicators for precision, accuracy, representativeness, completeness, comparability, and quantitation limits (defined in Section 4.0) to determine whether acceptance criteria have been met
- A review of project-specific DQOs to determine whether they have been achieved by the data collected
- An evaluation of any limitations associated with the decisions to be made based on the data collected. For example, if data completeness is only 85 percent compared to a project-specific completeness objective of 95 percent, the data may still be usable to support a decision, but at a lower level of confidence.

Any report or technical memorandum in which data for this project is reported will discuss any potential impacts of these reviews on data usability and will clearly define any limitations associated with the data.

13.6 DOCUMENTATION AND RECORDS

13.6.1 Project Personnel Responsibilities

The individuals responsible for data management for this project include:

Field Team Leader:

- Provides information in writing to the sampling crew on the sample location and sampling requirements
- Reviews and initials the sampling forms to insure that all samples were collected appropriately.

Project Chemist or designee:

- Inspects laboratory data deliverables (both hard copy and EDD) for completeness
- Saves EDDs into appropriate locations on PWT server and verifies the accuracy of EDD import to SCRIBE or other electronic databases
- Incorporates hard copy lab deliverables to project filing system.

PWT Field Team:

- Provides written notification to laboratory of upcoming sampling activity and arranges for a sufficient supply of sample bottles and sample coolers
- Generates sample labels and initiates chain-of-custody form
- Compiles field forms, field notes, chain-of-custody forms and other field documentation and updates the project files to provide a traceable record for data collection activities.

13.6.2 Sample Locations

Each sample location will be assigned a unique "Site Code", which is a series of two letters and a two digit number, in an effort to keep the naming conventions consistent with the historic sample data from the Site which is contained in the master MS Access database. The sampling unit polygons with associated samples will be maintained in an ArcGIS 10 geodatabase structure called "EH_Basedata," along with other pertinent local geographic data, such as road centerlines, streams and wetland polygons. All geographic data will be documented with Federal Geographic Data Committee compatible metadata, allowing future users to identify the original source and processing steps of the GIS data. GIS mapping, data collection, reporting, and transmittal will be in accordance with *National Geospatial Data Policy (CIO 2131.0)* (USEPA 2008), the *COI Policy Transmittal 05-002* (USEPA 2005), *and Federal Geographic Data Committee Geospatial Positioning Accuracy Standards (FGDC-STD-007.1-1998)* (FGDC 1998) and PWT's Spatial Data Submittals SOP (PWT-ENSE-402).

13.6.3 Analytical Data

The EPA's CLP will provide analytical data as individual EDDs from the assigned CLP analytical laboratories for soil samples are generated during respective sampling investigations related to this QAPP. Laboratory analytical data contained in the EDDs will be imported from the table/database into SCRIBE for the EPA to retain and use. The analytical data may then be exported from SCRIBE into the existing Microsoft Access master database, or into Microsoft Excel if needed.

Analytical data acquired from historical field sampling at the Site has been organized into a Microsoft Access database structure. Pursuant to discussions with the EPA, PWT will ensure that this Microsoft Access database is accessible to the GIS system by joining and relating the analytical data records, using the unique Site Code, Sample Number and Sample Unit code information that the historical analytical data and new analytical data will share. This database will be housed at the LEAP offices in East Helena.

13.6.4 Documents and Photographs

The PWT Team will manage all future data collected for the RD, while the historical data will continue to be housed in the LEAP offices. Field notes and data collection forms generated in accordance to this QAPP and its associated FSPs will be maintained in the PWT office in Helena, Montana throughout the field activities, where they will be scanned and archived electronically. Weekly electronic backups of the project data will also be stored offsite at PWT's Wheat Ridge office server. Every document and photograph relating to an individual property will be identified with the property identification number, or site code. The originals will be retained for the duration of the project. Each property will have a unique electronic folder containing access agreements, correspondence, photographs, field notes, and remedial design packages. All project records will be stored by PWT and will be made available to the EPA for a total of 10 years after final payment under the present contract.

This QAPP and any associated FSPs will be approved by the PWT Project Manager, Chemical QA Officer, and RAC 2 QA Officer, or qualified and suitable designees. QAPPs will be approved by the EPA before any WA data collection efforts begin. All QAPPs will be reviewed annually and updated as necessary using the current EPA Region 8 QA Document Review Crosswalk. The completed crosswalk review will be included with the requests for the EPA's approval. The life of a QAPP is for the duration of the specific project until it is closed out, providing the QAPP is reviewed annually, the annual reviews are documented and reported, the QAPP is updated to reflect changes noted by the annual reviews, and the specific project DQOs do not change.

Reviews of the QAPP will be documented in the PWT project files and addressed in project status reports as appropriate. Any changes required as the result of these reviews will be incorporated in the record copies as revisions and obsolete materials are identified. All personnel will be advised of changes. The PWT Program Manager, Project Manager, and QA Officer are responsible for making sure that all PWT technical staff who perform work on the East Helena Superfund Site, OU2, use only current versions of these controlled documents.

14.0 REFERENCES

CH2M Hill. 1998. *Memorandum to the EPA, East Helena Soil Sampling- Railroad Right-of-Way.* January.

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USEPA. 1994. *Guidance For The Data Quality Objectives Process (EPA QA/G-4).* September.

USEPA. 2000. *Guidance for Data Quality Assessment, Practical Methods for Data Analysis (EPA QA/G-9), QA00 Update*. July.

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USEPA. 2005. *National Geospatial Data Policy, CIO Policy Transmittal 05-002. (CIO 05-002).* August.

USEPA. 2006a. *Guidance on Systematic Planning Using the Data Quality Objectives Process (EPA QA/G-4)*. February.

USEPA. 2006b. *Data Quality Assessment: A Reviewer's Guide (EPA QA/G-9R)*. February.

USEPA. 2006c. *Data Quality Assessment: Statistical Methods for Practitioners (EPA QA/G-9S)*. February.

USEPA. 2008. *National Geospatial Data Policy (CIO 2131.0)*. August.

USEPA. 2009a. *East Helena Superfund Site, Operable Unit No. 2, Residential Soils and Undeveloped Lands, Final Record of Decision.* September.

USEPA. 2009b. *Guidance for Labelling Externally Validated Laboratory Analytical Data for Superfund Use (EPA-540-R-08-005)*. January.

USEPA. 2010a. *Contract Laboratory Program Guidance for Field Samplers.* EPA 540-R-09-03. May.

USEPA. 2010b. *U.S. EPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review*. EPA 540-R-10-011. January.

USEPA. 2011. *East Helena Superfund Site. Third Five Year Review*. September.

APPENDIX A

STANDARD OPERATING PROCEDURES

PWT-ENSE-402 SPATIAL DATA SUBMITTALS

PWT-ENSE-406 SAMPLE HANDLING

PWT-ENSE-413 UTILITY CLEARANCE

PWT-ENSE-418-BOREHOLE LOGGING

PWT-ENSE-423 INVESTIGATION DERIVED WASTE MANAGEMENT

PWT-ENSE-424 PERSONNEL AND EQUIPMENT DECONTAMINATION

PWT-ENSE-427 SURFACE SOIL SAMPLING FOR INORGANICS

PWT STANDARD OPERATING PROCEDURE

SPATIAL DATA MANAGEMENT

Procedure No. PWT-ENSE-402
Revision 3
Date effective: 04/11/14

APPROVED: ______________________ 5/5/14
PWT Project Manager, Date

Contents

List of Attachments

REVISION LOG		
Revision Number	**Description**	**Date**
1.1	Original SOP	September 2002
2.0	QA Review and Update	April 2012
3.0	Incorporate January 2014 EPA Guidance	March 2014

ANNUAL REVIEW LOG		
Revision Reviewed	**Description**	**Date**
2.0	Annual QA Review	August 2013

1.0 INTRODUCTION

This manual provides instructions for the management of spatial data by Pacific Western Technologies (PWT) on Environmental Protection Agency projects. All project managers and Geographic Information System (GIS) specialists should insure that spatial data is managed in a manner consistent with requirements in this SOP. In most cases this SOP applies to maps, drawings and other deliverables created in ESRI's ArcGIS software or Autodesk's AUTOCAD (CAD) software.

In general, there are three major components involved in the management of spatial data. The first phase occurs during project initiation. The second phase involves spatial data management activities during project implementation and the third phase involves spatial data submittals to EPA as part of project completion and /or closeout. The National Geospatial Data Policy (NGDP) establishes principles, responsibilities, and requirements for collecting and managing geospatial data used by the U.S. Environmental Protection Agency (EPA). Within EPA Region 8, GIS file delivery formats for all materials developed in support of CERCLA related site work are specified in the GIS Deliverable Guidance in Attachment A. All geospatial data that is collected, acquired, or managed in conjunction with an EPA project must comply with the requirements specified in this document.

2.0 SPATIAL DATA MANAGEMENT AT PROJECT INITIATION

It is often the case that upon receipt of a new project, the Project Manager will receive electronic files and/or documents that may include spatial data generated by a previous contractor or potentially responsible party (PRP). At this stage the project manager in conjunction with GIS/CAD specialists must determine the geographic coordinate system or projected coordinate system under which these data were produced. In cases where PWT will be generating all new deliverables on the project it is important to determine if the previous coordinate system should continue to be used on the project or whether the spatial data should be converted to a coordinate system that is more applicable to the project. Alternatively, on oversight projects where PWT will be receiving spatial data and deliverables from the PRPs or their contractors, maintaining spatial data in the same coordinate system as it was received is preferable. Maintaining spatial data in different coordinate systems should be avoided. In most cases, spatial data will be maintained and reproduced using the state plane projected coordinate system for the state in which the work is being performed. Unless stipulated otherwise, all data sources should use the appropriate State Plane Coordinate System with the following parameters defined:

COORDINATE SYSTEM:	State Plane [ex. Colorado]
ZONE:	State Specific [ex. Colorado Central]
DATUM:	ex. NAD83
SPHEROID:	ex. GRS80
UNITS:	Feet

2.1 DIRECTORY STRUCTURE

During project setup the project manager or designee should implement a project file structure that will contain the results of spatial and other data and deliverables on the project. The following folder structure incorporates the suggested folder structure in the GIS Deliverable Guidance and is improved to better handle PWT products and deliverables. The desktop and user areas on individual workstation should not be used to store project directories. The following project folder structure should be established for geospatial data and deliverables on each project:

Main Folder: **Project_Name** (ex. WA125 Vasquez Blvd. OU2). If the project is being conducted under multiple work authorizations (WAs), a more generic project name can be considered such as "Vasquez Blvd/I70 Superfund Site." Project related folders in addition to the folders used for geospatial data will also be located under the main folder.

Folder: **Geospatial_Info**: This directory holds all subfolders created below. It may also contain any work instructions or correspondence related to map or figure preparation.

Subfolder: **Images:** aerial photos, satellite imagery, logos, DEMs, and other raster type data

Subfolder: **Maps:** .MXDs and .PDF files). Map names should use the project name as a prefix

Subfolder: **Shapes:** geodatabases, shape files, and other approved vector data formats. All data used by mxds in the **Maps** directory should be located here. This insures data links and facilitates project portability.

Subfolder: **Drawings:** .DWG and .DXF files and other CAD related files

Subfolder: **Source:** original unmodified data that may have been acquired from external/internal sources

Subfolder: **Tables:** MS-Access databases, spreadsheets, delimited text files, or other such tabular data used to make maps or figures

Subfolder: **Archive:** storage for any previous versions of documents that are kept for reference

3.0 SPATIAL DATA MANAGEMENT DURING PROJECT EXECUTION

During project execution there will be a need to manage geospatial data and products in an effective manner so that the progression of data and deliverables can be identified and managed appropriately. The following subsections provide guidelines for proper geospatial data management.

3.1 FILE NAMING CONVENTIONS

File naming conventions need to be consistent to allow PWT staff to easily find related files for comparison, integration, or duplicate elimination. Each data source filename should include a project identifier prefix (RMA, USM, CMX, etc.) and a clear descriptor based on the map name. Each part of the filename may be separated by an underscore but special characters or spaces should not be used in filenames. For example, a map created for Rocky Mountain Arsenal may be identified as "RMA_OffpostTreatmentPlant.mxd," or CMX_Bldg1002.shp for a shapefile created for the

CEMEX project. Use a condensed version of the document title as the filename. (On some older systems a path and filename cannot exceed 256 characters combined.) Use capitalization to separate words. If it is necessary to distinguish a data source developed by an outside entity for public use from one developed for PWT directly, add an additional identifying prefix, i.e RMA_USGS_topo2012.shp or USM_TooeleCntyPLSS.mxd

3.2 SERIES or VERSION IDENTIFICATION

Maintaining successive versions of the same map or shapefile may be necessary because they may be included in succeeding versions of documents or handouts. The date of creation should be used in a MMDDYY format as a suffix for files. An example format may be "RMA_SplitSamples_120312" to identify a drawing, map or shapefile for groundwater split samples collected at Rocky Mountain Arsenal created in December 2012. For periodically collected data, where the same base map will be used to display temporally different information, a modified suffix can be used to distinguish one version of a map or shapefile from another. For example, for quarterly samples, the quarter can be substituted for the date such as RMA_NBCS_2011Q3_120312 for the third quarter treatment plant samples collected at the North Boundary Containment System in 2011 displayed on a map created in December 2012. Do not use words like new and old to describe versions. Once all previous versions have been discarded or moved to the Archive directory, PWT personnel can decide how to reconcile any edits and drop the date suffix from the final version that results. For example it is acceptable to substitute "dft", "dft_fnl" and "fin" for draft, draft_final, and final versions of figures or maps that correspond to the version of the document that was issued to the client. Final deliverable versions may also use the suffix "_REV0."

3.2.1 SUFFIX – CATEGORY

Categorical suffixes should be considered to classify the type of data in a given map or shapefile. If a data source fits two categories or falls into a category not yet defined, a new suffix should be developed with the consensus of the project manager. As an example, a shapefile or CAD drawing file using a categorical suffix might be RMA_Railyard_gw_091012.shp to identify groundwater data from the Railyard Extraction System at Rocky Mountain Arsenal. Example suffixes are listed below.

air – air sample locations

ast – above-ground storage tank

B### – building number to proceed name of environmental samples collected within a building

bh – borehole

bldg – building

bnd – boundary

cov – cap or cover

ctr – contours

elev – point elevations

exc – excavation

fnc – fence

gs - gas

gw – groundwater

OU# – operable unit identifier (such as OU3)

Q# – quarter (such as Q3 for third quarter)

prop – property map

rd – road

rr – railroad

sdwk – sidewalk

soil – soil

str – stream

sw – surface water

swr – sewer collection system features

stm – storm water collection system features

tel – telecommunication system features

tp – treatment plant

ust – underground storage tank

utl – utility

veg – vegetation

well - well

wl – water level

wtr – water distribution system features (e.g. domestic water line)

3.3 THE ARCGIS MAP DOCUMENT (*.mxd)

An ArcGIS map document (*.mxd) will be generated for each map produced for a project. All map documents should be stored in the ***Maps*** directory, either at the root level of the directory structure for sitewide projects, or within a subdirectory labeled with its project area (e.g. Lime Basins). All maps must include a file path in the lower left corner. Insert text and paste 'Path: <dyn type="document" property="path"/>' into it. This will reference any resulting document to the mxd that created it. Include the date of any imagery used as a background in the legend. The map document will contain links to shapefiles used to make the map. If a shapefile is moved to a different subfolder than the one from which the shapefile was imported to the map, the link to this shapefile will be lost and will no longer be displayed on the map. To avoid this problem, all shapefiles should be located in the shapes subfolder. Each map or figure should contain a legend which provides, at a minimum, the following information:

1. Names of active shapefiles used in the map
2. North arrow and map scale, including units
3. Definition of symbols used on the map
4. Company logo and client logo (if available)
5. Map author and creation date
6. Map reviewer and approval date

3.4 THE ARCGIS SHAPEFILE (.shp)

All vector data sources used in ArcGIS are contained in shapefiles which will be defined as points, lines, or polygons and will have a .shp suffix at the end. However these shapefiles are actually composed of five to six separate files which combine to make the shapefile. These individual files should never be edited individually and all editing of the shapefile should be done in ArcMap, ArcCatalog or ArcToolbox. File corruption will result otherwise. All shapefiles should be stored in the ***Shapes*** project subfolder. The shapefiles can be stored as geodatabases or stand-alone. ArcGIS includes conversion tools in ArcCatalog and ArcToolbox that allow other formats to be converted into shapefiles for geodatabases; however, to ensure maximum convertibility, it is best to generate data directly as shapefiles in ArcMap.

Vector data that is used in GIS application must be in shapefile format. Do not store shapefile or personal geodatabases as zipped files as this sometimes corrupts the data.

3.5 THE CAD DRAWING FILE (.dwg)

A CAD drawing file (*.dwg) will be generated for each drawing produced for a project in CAD. All drawings should be stored in the ***Drawings*** directory, either at the root level of the directory structure for sitewide projects, or within a subdirectory labeled with its project area (e.g. Lime Basins). All drawings must include a file path in the lower left corner. This will reference any resulting figure to the .dwg file that created it. Include the date of any imagery used as a background in the legend. The drawing file may contain links external references and blocks existing in other CAD files, or to tables of points or other imagery used to make the figure. If source files are renamed or moved to a different subfolder than the one from which the link was generated, the link to this external data will be lost and will no longer be displayed on the figure. To avoid this problem, all externally referenced data sources should be located in the appropriate subfolder (Images, Tables, Shapes, Drawings, etc). Each drawing or figure should contain a legend which provides, at a minimum, the following information:

1. Names of active source files used in the map (if it is not appropriate to record this information on the legend, include a word document in the Drawings subfolder listing active source files)
2. North arrow and map scale, including units
3. Definition of symbols used on the figure
4. Company logo and client logo (if available)
5. Map author and creation date
6. Map reviewer and approval date

3.6 NON-VECTOR DATA

Image data should be provided in TIFF file format (*.tif, *.tfw). A worldfile that provides spatial reference information (*.tfw) should accompany each TIFF file (*.tif). Digital elevation models or other grid-based data should be provided in ESRI ArcInfo GRID file format, which is stored in a named directory and always accompanied by an INFO directory at the same level in the directory structure.

3.7 METADATA

Each spatial data source and GIS map **must** be accompanied by a metadata XML file that describes its content and all files must use the FGDC CSDGM Metadata template found in attachment A. The metadata file can be created or edited by choosing the data source name listed in the table of contents in ArcCatalog then selecting the *description* tab. For CAD drawings, metadata should be recorded in a word document stored in the same folder as the .DWG file. In general, the same information should be recorded for both GIS maps and CAD drawings.
Edit metadata files to include a short summary, the name of the map creator, a data description, its source, and any limitations on use. The metadata should indicate if any symbols or map elements were used that are not found in the PWT map style and if a PWT-approved map template did not serve as the basis for the map. A CAD MetaData Entry form is included as Attachment B.

4.0 SPATIAL DATA MANAGEMENT AT PROJECT COMPLETION

Most projects involve sequential completion of deliverables which may include preparation of maps, figures and drawings as components to a report or plan. In most cases these figures will be saved and transmitted to the client as PDF files. Transmission of files in PDF format eliminates the need for the client to have the appropriate software and software version to read the document. When creating PDF files in ARGIS it is important to check the “embed all document fonts” box under the Format tab in the export function. Otherwise these fonts will not show up on the client’s version of the map if they do not have those fonts on their computer. If the project manager has created folders for draft, draft-final and final versions of the document, it is advisable to locate the PDF files used for that document in the same folder so that re-issue of the document at a later date can be performed easily.

4.1 SUBMITTAL OF FINAL SPATIAL DATA FILES TO EPA

At contract closeout, or completion of a project (or stage of a project if it is a large project), EPA Region 8 has stipulated how spatial data files are to be submitted. Final versions of GIS files will be submitted in the format stipulated in NGDP guidance in Attachment A. The accepted projection for GIS deliverables is decimal degrees with the minimum information that needs to be provided as follows:

ID – a unique identifier given to each feature
Latitude – the Y coordinate in decimal degrees, 6 significant digits
Longitude – the X coordinate in decimal degrees, 6 significant digits
Horizontal Datum – the datum of the coordinates.

This will necessitate conversion of GIS files from the projected coordinate system used on the project to the geographic coordinate system identified above. All CAD and image file data must also be delivered in known real world coordinate space (typically as identified above) and not in paper space or in a custom site specific projection. The NGDP guidance stipulates that final maps or drawings submitted in PDF format have at least 300 dot-per-inch resolution.
EPA contracts typically stipulate the time duration that PWT must maintain data and deliverables for projects. The project manager should insure that project data is archived and maintained for the period specified in the contract.

ATTACHMENT A

U.S. EPA Region 8
GIS Deliverable Guidance

Region 8 Ecosystems Protection and Remediation

Program Support

Data Systems Team

GIS

Version 1.0 January 6, 2014

Document Revision	Author	Version	Description
1/6/14	John Wieber	1.0	Final

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Contents

Purpose

The purpose of this document is to provide guidance to contractors, grantees, or others who provide GIS deliverables to EPA Region 8 programs, projects, or staff.

Scope

This document covers the types of GIS deliverables anticipated in Region 8 and how the Region would like to receive these deliverables. Additionally, data standards, formats, and best management practices are identified.

Responsibilities

The Region 8 GIS team is responsible for maintaining this document and providing it to those parties wishing to provide Region 8 with spatial data or products. It is the responsibility of those providing deliverables to the Region to adhere to the guidance provided in this document to the best of their abilities. The Region 8 GIS team relies on other EPA staff such as grant/contracting officers, RPMs, and inspectors to ensure data are getting submitted for long-term use at EPA.

Introduction

This document is intended to specify GIS file delivery formats for all geospatial materials developed in support of GIS related work within EPA Region 8. It is the intent of EPA Region 8 to acquire, catalog and manage all GIS files comprehensively across all projects to:

1) ensure future use and access to EPA,
2) provide an archive of work accomplished,
3) maintain and serve data that spatially represent features pertinent to on-going EPA efforts, and
4) provide a basis for future activities such as CERCLA Five Year Review.

GIS Formatted Data Files

All final version spatially enabled files acquired or developed to support mapping and/or spatial analysis by a contractor or grantee are considered property of the EPA and are required to be submitted to EPA. Delivery schedules are negotiable, but should be annual at a minimum. This includes but is not limited to all GIS, CAD, and image formatted files used to develop maps for any scoping or decision document developed for EPA, as well as any spatial file used to inform a decision on site management or development. Only final versions of each layer are required for delivery to EPA, and must be in an approved format as specified in this document. In addition, all electronic geospatial data, whether vector or raster, must be projection defined (have a projection defined and embedded in or associated with the data file), and in the case of CAD data must NOT be in page space or a custom site-specific projection. All CAD data must be in known real world coordinate space, ideally conforming to the projection specifications outlined below. Should tabular data be appropriate to connect location information with attribute information, then documentation specifying the primary and foreign keys is required. Should coordinate information be provided in tabular format it should contain at minimum the following fields:

ID – a unique identifier given to each feature
Latitude – the Y coordinate in decimal degrees, 6 significant digits
Longitude – the X coordinate in decimal degrees, 6 significant digits
Horizontal Datum – the datum of the coordinates.

Additionally all static maps that appear in an EPA document should be in an electronic Adobe PDF format with fonts embedded and at a resolution of 300 dots per inch (dpi) or greater. Finally, any dynamic maps used in final map production, such as ESRI ArcMap documents (.mxd), may also required for delivery to EPA with accompanying data in a stand-alone directory structure. Such documents are recommended to be provided as ESRI map packages (.mpk).

Projection Requirements

All GIS files submitted to EPA must have spatial reference information that describes the projection, datum, and where applicable the collection methods. The EPA requests that all vector data be submitted in geographic coordinate system, decimal degree units, and NAD83 datum, as is required under the EPA National Geospatial Data Policy, 2008. Raster data, such as aerial photographs may be submitted in their native projection, and maps should be in the appropriate projection/coordinate system for the area depicted. EPA Region 8 GIS staff will be happy to consult and advise on projection, coordinate, and datum details for submission to EPA.

Metadata Requirements

All GIS files developed for EPA are required by Executive Order 12906 to have associated metadata. EPA requires FGDC compliant metadata on all GIS files developed for site support. Region 8 also requires that all dynamic maps (ArcMap documents) have metadata completed. The Content Standard for Digital Geospatial Metadata can be found at www.fgdc.gov. Metadata, including information about the data's projection, can be developed using one of several built-in or add on tools within a GIS, and typically is associated with the geometry file as an XML file. EPA Region 8 GIS staff will be happy to consult and advise on development of required metadata.

Organizational Requirements

If the project is complex, a directory structure and readme text file in the upper level directory that describes the structure is required. Because EPA will be managing data across many projects, it is important to make your submittals as understandable as possible. A recommended directory structure is as follows:

<**Project_Name**>
|_ **Docs** (reports, SOPs, correspondence, and other such documents)
|_ **Images** (aerial photos, satellite imagery, logos, DEMs, and other raster type data)
|_ **Maps** (MXDs and PDFs. Map names should use the project name as a prefix)
|_ **Shapes** (geodatabases, shape files, and other approved vector data formats)
|_ **Source** (original unmodified data that may have been acquired from external/internal sources)
|_ **Tables** (MS-Access databases, spreadsheets, delimited text files, or other such tabular data not stored in a geodatabase)

File naming conventions should be logical, consistent, and contain no spaces or special characters. An underscore may be used in lieu of a space.

Delivery Requirements

EPA will accept data delivered on CD-Rom, DVD, or external hard drive, as well as direct electronic submission via email or FTP site. Other delivery methods may be allowed if those requirements present a significant burden or as technology changes.

EPA Acceptable Data Formats

The following file formats are considered acceptable and all maps and data must include an associated metadata document:

DATA
Vector **projected to geographic, decimal degrees, NAD83**
File Geodatabase (.gdb) *Preferred Shape File (.shp, .shx, .dbf, .prj, .sbx, .sbn) Personal Geodatabase (.mdb) ESRI Map Package (.mpk)
Raster **native projection acceptable**
TIFF image with world reference file or as a GeoTIFF (.tif, .tfw) JPEG image with world reference file (.jpg, .jpw) ERDAS Imagine image with pyramid file (.img, .rrd) MrSid image (.sid) ESRI Grid DEM
TINs **appropriate projection/coordinate system for the area depicted**
ESRI TIN
CAD **projected to geographic, decimal degrees, NAD83**
DXF layer separates (.dxf)
Tabular **primary keys should be clearly identified/documented**
MS-Access database (.mdb) MS-Excel spreadsheet (.xls) Delimited text file (.txt,
MAPS
Static
Adobe PDF at 300 dpi or better with embedded fonts (.pdf)
Dynamic
ESRI Map Package (.mpk)

FGDC Compliant METADATA
XML (.xml)

CHECKLIST

The following checklist may be used to assist in complying with these standards:

DATA

- ☐ Is each vector file, CAD included, in geographic, decimal degrees, NAD83?
- ☐ Is each raster file in its native projection?
- ☐ Is each data file one of the EPA acceptable formats?
- ☐ Does each data file have FGDC compliant metadata in an associated file?
- ☐ Are the primary and foreign keys documented for tabular data?
- ☐ Is a README text file included with a directory structure explaining how the structure is organized?

MAPS

- ☐ Is each static map provided in an electronic format at a resolution of 300 dpi or higher?
- ☐ Does each static map have fonts embedded?
- ☐ Has the page and print setup for map documents been configured to NOT use printer-specific paper settings?
- ☐ Are map documents set to use relative paths?
- ☐ Are map names prefixed with the project name?
- ☐ Are map documents accompanied with their relevant data in a stand-alone directory structure?
- ☐ Does each map have FGDC compliant metadata in an associated file?

ATTACHMENT B

Meta Data Entry Form

Spatial Metadata

<u>REQUIRED INFORMATION:</u>

Data Source (organization):

Contact (Person, Organization, Telephone, E-mail, and Address):

Citation Information (Title, Originator, Publication Date):

File type or format:

Spatial Reference (map projection and units):

Abstract (a brief narrative summary of the dataset):

Purpose (a summary of the intentions with which the data set was developed):

Use Constraints (restrictions and legal pre-requisites for using the data set after access is granted):

PWT STANDARD OPERATING PROCEDURE

APPROVED: ______________________ September 27, 2013
PWT Project Manager, Greg Hayes Date

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REVISION LOG		
Revision Number	**Description**	**Date**
1.0	Original SOP	July 2011
2.0	QA Review and Update	March 2012

ANNUAL REVIEW LOG		
Revision Reviewed	**Description**	**Date**
2.0	Annual QA Review	August 2013

1.0 PURPOSE AND SCOPE

This Standard Operating Procedure (SOP) provides technical guidance and methods that will be used to handle environmental samples (such as: soil, groundwater, surface water, sediment, waste, and air samples) during environmental investigations. This SOP serves as a supplement to site-wide and investigation area specific workplans and the site-specific Quality Assurance Project Plan (QAPP) and may be used in conjunction with other SOPs.

2.0 REQUIREMENTS

The following sections identify the requirements for Quality Assurance / Quality Control (QA/QC), health and safety, and personnel qualifications for sample handling.

2.1. Quality Assurance / Quality Control

Follow all QA/QC requirements identified for the project as identified in approved project planning document(s).

2.2. Health and Safety

Follow health and safety requirements identified in the Site-Specific Health and Safety Plan, Job Safety Analyses (JSAs), any applicable Task-Specific Health and Safety Plans prepared by PWT Subcontractors, and the associated Activity Hazard Analyses (AHAs).

2.3. Personnel Qualifications

Personnel performing sample handling activities will have knowledge and experience in the equipment and procedures used, or will work under the direct field supervision of knowledgeable and experienced personnel. Sample handling will be directed by a PWT field sample manager responsible for ensuring proper handling and shipment of samples. The field sample manager will be knowledgeable and experienced in handling and shipping of environmental samples.

3.0 MATERIALS AND EQUIPMENT

The following materials and equipment may be needed for sample handling, packaging, and shipping:

- Monitoring equipment and personal protective equipment (PPE) as specified in the HASP.
- Appropriate clean sample containers as specified for each analytical method being tested. Sample containers will contain appropriate preservatives, according to method specifications. Sample containers will be provided by the analytical laboratory, unless otherwise specified in the QAPP.
- Decontamination equipment and supplies (e.g., wash/rinse tubs, brushes, Alconox, plastic sheeting, paper towels, sponges, baby wipes, garden-type water sprayers, large plastic bags, potable water, distilled water and/or deionized water).
- Sample handling supplies (e.g., recloseable plastic bags, waterproof markers and sample labels, cooler for sample storage, ice or ice substitute).
- Sample management supplies (e.g., soil sample field data sheets, chain-of-custody [COC] forms). An example COC form is included as Attachment A.
- Sample shipping supplies (shipping coolers, recloseable plastic bags, shipping labels, shipping forms [provided by shipping courier], bubble wrap, tape [e.g., clear tape, packing tape, and custody seal tape]).

Other materials and equipment may be needed based on field conditions.

4.0 PROCEDURES

4.1 Sample Identification

Samples collected during investigation activities will be identified using a pre-determined sample identification (ID) scheme described in the project or investigation –specific sampling plan.

Typically, sample ID numbers consist of two main components:

- The investigation location site identifier, which may include numbers, letters, or a combination of the two, and which corresponds to the investigation location at which the sample was collected
- Sample-specific information, such as the sample collection method, sample depth interval, sample type and sequential sample number

4.2 Sample Labeling

Sample labels will be filled out to the extent possible before field sampling activities begin. However, the date, time, sample depth, and sampler's initials or signature will typically not be completed until the time of sample collection. Sample labels will be filled out using waterproof ink. At a minimum, each label will contain the following information:

- Company’s name
- Project name/site location
- Sample ID
- Date and time of sample collection
- Method of preservation (if any) used
- Analyses required
- Sample matrix (e.g., soil, water)
- Sampler initials

4.3 Sample Handling

This section discusses proper sample containers, preservatives, and handling and shipping procedures.

4.3.1 Sample Containers

Unless otherwise specified in the QAPP, clean sample containers will be obtained from the subcontracted analytical laboratory performing the analyses. Extra containers will be ordered to account for the possibility of breakage during shipment or sample collection. To the extent possible, required preservatives will be prepared and placed in the bottles at the laboratory before shipment to the site. Project-specific sample containers will be identified in the site-specific QAPP.

4.3.2 Sample Preservation

Samples will be preserved in accordance with the site-specific QAPP. Chemical preservatives, if necessary, will be added to the sample containers by the laboratory (or vendor) before shipment to the field. Samples will be stored at appropriate temperatures as specified in the site-specific QAPP.

4.3.3 Sample Handling and Shipping

Sample containers will be packaged properly to prevent breakage of containers and leakage of contents. The following procedures will be followed during the packaging and shipping process:

1. Place sample containers in recloseable plastic bags.
2. If sample container is glass, wrap individual sample containers with bubble wrap.
3. Place sufficient amounts of bubble wrap in the bottom and sides of the shipping cooler to prevent movement of contents.
4. Add enough ice (in double bags) or ice substitute to the cooler to maintain proper preservation temperature in accordance with the QAPP.
5. Line the inside of the cooler with a plastic trash bag, place the samples and additional ice as necessary inside, and tie the bag shut.
6. Fill any void space in the cooler with packing material (e.g., bubble wrap) to prevent movement of sample containers.
7. Place the original COC form inside a recloseable plastic bag, and tape the bag to the inside of the cooler lid.
8. Close the cooler lid, and seal the cooler and the cooler drain spout with appropriate packaging tape.
9. Place two custody seals (tampering seals) on the cooler in separate areas over (across) the seal between the lid and the cooler base. Example custody seals are included as Attachment B.

A shipping bill should be completed for the shipper and taped to the top of the cooler using the envelope provided by the shipper. The following markings may also be placed on the top of the cooler:

- This end up
- Fragile
- Laboratory delivery address
- Sender's return address

A copy of the shipping bill will be retained by the field sample manager for attachment to the corresponding COC form. Samples will be hand delivered or shipped by express courier for delivery to the analytical laboratory.

The field sample manager or field team leader is responsible for verifying that samples collected by the field team(s) have been properly identified, preserved, and packaged, and for verifying the accuracy and completeness of sample labels, COC forms, and applicable sample field data sheets and logbook entries.

The following is a summary of steps to be performed by the field sample manager:

- Verify sample labels.
- Verify samples were collected and preserved in accordance with the site-specific FSP and QAPP.
- Check or complete the COC form, photocopy, and retain a copy for the project files.
- Pack samples in shipping containers and verify labels and shipping forms meet shipping requirements.
- Send original COC form to the laboratory.
- Retain a copy of the shipping bill and staple it to the corresponding COC copy.
- Send copies of sample field data sheets and photocopied pages of field logbooks to the project manager.

Close coordination will be maintained between the field sample manager and the analytical laboratory during sample collection and shipment. The laboratory will be instructed to report any handling or preservation issues immediately to the field sample manager (or other designated person) so that corrections can be made to field procedures, if necessary.

4.3.4 Sample Container Tampering

If, at any time after samples have been secured, custody seals on the cooler are identified as having been tampered with, the following procedures will be conducted to ensure that sample integrity has not been compromised:

- Check with personnel having access to sample coolers to assess the possibility of inadvertent breakage of custody seals.
- Inspect sample containers for signs of tampering, such as loose lids, foreign objects in containers, or broken or leaking containers.
- Review sample packaging and handling procedures.
- Document findings of the incident in the sample management logbook.

If it is determined that intentional tampering of samples has occurred, or it is believed that sample integrity has been compromised in any way, the Quality Assurance Officer and appropriate project managers will be notified.

4.3.5 Holding Times and Analyses

Samples will be shipped to the analytical laboratory for analysis as soon as practical following collection. At a minimum, samples will be shipped daily with the following exception. For small projects, samples may be collected over a period of several days at the discretion of the project managers, and then collectively shipped. No samples will be shipped on Friday for weekend delivery unless receipt and analysis procedures are pre-coordinated with the analytical laboratory. Allowable holding times for specific samples will be specified in the site-specific QAPP.

5.0 DOCUMENTATION

Documentation of sample handling is critical to project defensibility. The field sample manager will be responsible for ensuring all sample collection and handling documentation is complete and accurate.

5.1 Sample Management Logbook

The field sample manager will maintain a complete and accurate sample management logbook documenting sample handling procedures and observations. The logbook will be a permanently bound weatherproof field logbook with consecutively numbered pages. The field sample manager will also maintain a complete and accurate sample management file containing copies of all sample field data sheets, sampling crew logbooks, COC forms, shipping documentation, and written logs of correspondence or communications with the laboratory and other pertinent correspondence and communications. The sample management logbook will contain sufficiently detailed information to allow all significant sampling issues to be reconstructed without relying on the memory of sampling personnel.

The sample management logbook will contain daily entries for the following information:

- Project name

- Sampling activities performed that day
- Sampling crews and affiliations
- Sample location identifications
- List of samples collected, including sample IDs, collection time/date, media, analysis methods, and associated COC and shipping documentation
- QA/QC samples collected and submitted for analysis
- Field observations
- Instrument calibration information
- Correspondence and communications
- Field sample manager's signature

Changes or deletions in the logbook will be lined out with a single strike mark, initialed and dated by the person making the change. Sufficient information should be recorded to allow the reason for the change to be reconstructed without relying on the memory of field personnel.

At the end of each day, the field sample manager will prepare copies of the sample management logbook, sample field data sheets, and field crew logbooks for the project manager. The field sample manager will coordinate with the project manager on the required frequency of transmittal of this information to the client. The client will expect this information to be available, accurate, and complete on a daily basis for possible inspection by the client, quality assurance personnel, the project manager or the regulatory agency.

5.2 Chain of Custody

Written documentation of the proper and secure handling of samples from the time samples are collected until laboratory data are issued is critical to project defensibility. The chain of custody of the physical sample and its corresponding documentation will be maintained throughout the handling of the sample. Sample custody applies to both the field and laboratory operations. Information on the custody, transfer, handling, and shipping of samples will be recorded on a COC form. An example COC form is provided as Attachment A. The COC form may consist of a triplicate, pressure-sensitive form or other form prepared by the contract laboratory, or the COC form may be electronically generated in the SCRIBE software. The COC form may vary depending on investigation activities. The investigation contractor will select an appropriate COC form subject to approval by the client.

A sample is under custody if it is in:

- The possession of the sampler/analyst.
- The view, after being in the possession, of the sampler/analyst.
- A sealed shipping container being carried by a designated commercial carrier.
- A designated secure area.

The sampling team will be responsible for initiating the original COC form and will sign and date the COC form when relinquishing sample custody to another person (e.g., the field sample manager) or to the analytical laboratory. The COC form and sample labels will be checked by the field sample manager to verify that samples are accounted for and in good condition, and that no errors were made.

The COC form will include the following information:

- COC number (unique, sequential number on the upper right corner of the form)
- Project name and number
- Sample ID number
- Sample preservatives
- Number of containers
- Sample collection date and time
- Sample matrix
- Requested analyses
- Signature and date blocks for personnel relinquishing or receiving sample custody
- Name and phone number of contractor contact person

Transfer of samples to the analytical laboratory may be via commercial carrier. The field sample manager will verify the proper packaging and shipment of samples. Prior to shipping, the field sample manager will officially transfer sample custody to the commercial carrier or analytical laboratory and secure the COC form inside the shipping container. Shipping containers transferred via commercial carrier will be sealed with strapping tape and with two custody seals. An example custody seal format is provided as Attachment B. Receipts of bills of lading from the carrier will be maintained as part of the custody record. Commercial carriers are not required to sign the COC form as long as the COC form is sealed inside the shipping container and the custody seals remain intact.

Upon receipt at the laboratory, the person receiving the samples will sign the COC form accepting transfer of custody to the laboratory. The laboratory will return a copy of the signed COC form to the designated investigation contractor personnel (i.e., project chemist, field sample manager, or project manager), and will retain a copy on file at the laboratory. The original COC form will remain with the samples until final disposition of the samples by the laboratory in accordance with the site-specific QAPP. After sample disposal, a copy of the original COC will be sent by the analytical laboratory to the investigation contractor.

ATTACHMENT A
EXAMPLE CHAIN OF CUSTODY FORM

Chain of Custody/ Request for Analysis Record

CC#

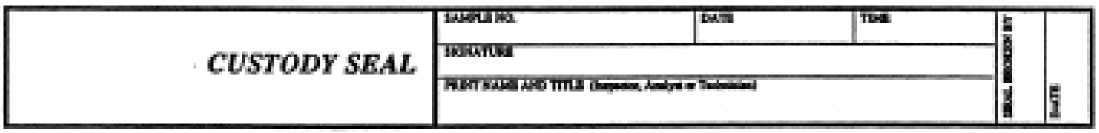
Client / Project Number / Sampler Name(s)/Signature(s)			Sample Data				Analyses Requested	Remarks or Sample Location	Preservation	
Sample Number	Date	Time	Material Sampled: S = Soil; L = Liquid; G = Gas	Sample Type*	Container Type: G = Glass; P = Plastic; M = Metal	Number of Containers			Iced	Specify Preservative Added and Final pH, If Known

Relinquished by (Signature): ①	Date	Time	Received by (Signature):	Relinquished by (Signature): ④	Date	Time	Shipped Via:
Relinquished by (Signature): ②	Date	Time	Received by (Signature):	Received for Laboratory by (Signature):	Date	Time	Shipping Ticket No:
Relinquished by (Signature): ③	Date	Time	Received by (Signature):	Name of Laboratory			Laboratory Control Number:

*G = Grab; C = Composite; S = Split Spoon; ST = Shelby Tube; O = Other

White = Original (To Accompany Sample); Yellow = Main Office; Pink = Field Copy

ATTACHMENT B
EXAMPLE CUSTODY SEAL


CUSTODY SEAL
SAMPLE NO.
DATE
TIME
SIGNATURE
PRINT NAME AND TITLE
SEAL BROKEN BY
DATE

Custody Seal

PWT STANDARD OPERATING PROCEDURE

APPROVED: ____________________ September 27, 2013
PWT Project Manager, Greg Hayes Date

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REVISION LOG		
Revision Number	**Description**	**Date**
0.0	Original SOP	July 2011
1.0	QA Review and Update	March 2012

ANNUAL REVIEW LOG		
Revision Reviewed	**Description**	**Date**
2.0	Annual QA Review	August 2013

1.0 PURPOSE

This Standard Operating Procedure (SOP) provides technical guidance and procedures for utility clearances at project sites. This SOP serves as a supplement to site-wide and investigation area specific workplans and the site-specific Quality Assurance Project Plan (QAPP) and may be used in conjunction with other SOPs.

2.0 REQUIREMENTS

2.1 Quality Assurance / Quality Control

Follow all QA/QC requirements identified for the project as identified in the approved project planning document(s).

2.2 Health and Safety

Follow health and safety requirements identified in the Site-Specific Health and Safety Plan (HASP), Job Safety Analyses (JSAs), any applicable Task-Specific HASPs prepared by PWT Subcontractors, and the associated Activity Hazard Analyses (AHAs).

3.0 RESPONSIBLE PERSONNEL

The project manager has the overall responsibility for implementing this SOP. The project manager will be responsible for assigning staff to implement this SOP and for ensuring that the procedures are followed by all personnel. The field team leader is responsible for ensuring that the appropriate utility clearances have been performed prior to any intrusive field activities. All utility clearances will comply with applicable portions of the Site-Specific HASP.

4.0 PROCEDURES

Locations selected for intrusive field activities (e.g. borehole drilling, trenching) will be cleared of utilities before field activities begin. Utilities may be located below ground or above ground. Before intrusive field activities can be performed each location will be cleared for the following utilities; natural gas, telecommunications, water and sewer, electrical, fiber optics and cable. At some locations additional utilities that may require clearance include petroleum service lines, irrigation lines, and building foundations. Locations selected for intrusive work must be visually cleared for overhead utilities by the project manager or designee. This overhead utility check shall be recorded in the field logbook. Location of underground utilities will require additional steps, as described below.

It is the responsibility of the project manager to contact utility organizations directly for utility clearance at least one week in advance of scheduled intrusive work. Some utility companies guarantee that they will be present at the scheduled meet time. Other utility companies may call to reschedule at a different time or day or reschedule the day of the scheduled utility meet. If possible the utility clearance should be done a few days prior to intrusive work to allow enough time for utilities companies to clear their lines. The utility companies will identify their utilities with spray paint on the ground. They also may leave a map or sketch at the location with their lines identified. In addition to the project manager (or designee), each subcontractor performing the actual intrusive work is required to attend the utility clearance, to pose any necessary questions. The subcontractors should request the same meet time that the PWT project manager has set up. A representative from each of the subcontractors is required to be present at the utility meet.

5.0 DOCUMENTATION

Underground and overhead utility clearance activities will be documented in the field logbook by the project manager, field team leader or rig geologist. The documentation will include the utility locator service sign-off, personnel present for the locate, the final project-site representative approval (if requested), and any current and historical maps used in locating utilities (or references to locations of maps for future reference).

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REVISION LOG		
Revision Number	Description	Date
0.0	Original SOP	July 2011
1.0	QA Review and Update	May 2012

ANNUAL REVIEW LOG		
Revision Reviewed	**Description**	**Date**
2.0	Annual QA Review	August 2013

1.0 PURPOSE AND SCOPE

This Standard Operating Procedure (SOP) provides technical guidance and methods that will be used to log boreholes drilled in unconsolidated and weathered bedrock during environmental investigations. This SOP serves as a supplement to site-wide and investigation area specific work plans and the site-specific Quality Assurance Project Plan (QAPP) and is intended to be used in conjunction with other SOPs.

2.0 REQUIREMENTS

The following sections identify the requirements for Quality Assurance / Quality Control (QA/QC), health and safety, and personnel qualifications for borehole logging.

2.1. Quality Assurance / Quality Control

Follow all QA/QC requirements identified for the project as identified in the site-specific planning documents (QAPP, Work Plan, etc).

2.2. Health and Safety

Follow health and safety requirements identified in the Site-Specific Health and Safety Plan (HASP), Job Safety Analyses (JSAs), any applicable Task-Specific Health and Safety Plans prepared by PWT Subcontractors, and the associated Activity Hazard Analyses (AHAs).

2.3. Personnel Qualifications

Personnel performing borehole logging are required to have completed the initial 40-hour OSHA classroom training that meets the Department of Labor requirements 29 CFR 1910.120(e)(3)(i), and must maintain a current training status by completing the appropriate annual 8-hour OSHA refresher courses. Personnel must also have read and signed the appropriate HASP(s). Prior to engaging in borehole logging activities, personnel must have a complete understanding of the procedures described within this SOP and, if necessary, will be given specific training regarding these procedures by other personnel experienced in the methods described within this SOP.

Personnel responsible for logging boreholes in unconsolidated and consolidated geologic material will be appropriately trained individuals with a minimum of a bachelor's degree in geology or a related field and have applicable field experience. Other qualified personnel may include geotechnical engineers or field technicians with an appropriate amount of applicable field experience or on-the-job training under the supervision of another qualified person.

3.0 MATERIALS AND EQUIPMENT

The following materials and equipment may be needed for borehole logging:

- Boring log form (Attachment A)
- Bound field notebook
- Waterproof pens
- Hand lens (10x magnification or higher)
- Latex or nitrile gloves and other required PPE
- Tape measure
- Stainless steel knife, screwdriver, rock hammer
- Decontamination equipment and supplies (e.g., wash/rinse tubs, brushes, Alconox, plastic sheeting, paper towels, sponges, baby wipes, garden-type water sprayers, large plastic bags, potable water, distilled water and/or deionized water)
- Electronic water level meter
- Appropriate field monitoring instruments (e.g., photoionization detector [PID], flame ionization detector [FID], combustible gas indicator [CGI]), as required by the HASP
- Reference tables listing ASTM and/or USCS codes and descriptions
- Munsel color chart

Other materials and equipment may be needed based on field conditions.

4.0 PROCEDURES

4.1 BORING LOG

The boring log is the primary record of observations of physical conditions encountered during borehole drilling. The primary purpose of the boring log is to document all pertinent information that may be necessary for someone other than the rig geologist to understand and interpret the geologic and hydrogeologic conditions observed during drilling. For example, at some sites, a critical issue is the contact between the unconsolidated material and the weathered bedrock, which may be readily apparent based on textural or color indications, or may be difficult to discern, requiring determination based on mineralogical properties. The boring log must provide sufficient textural, color, and mineralogical information so that someone other than the rig geologist can understand the basis for identification of those items, conditions or locations which are critical to the specific investigation or project.

Each borehole will be drilled and sampled in accordance with an appropriate drilling and sampling SOP. The rig geologist will be responsible for preparing detailed, complete, and accurate boring logs in the field using the boring log form (Attachment A) as drilling progresses. The preparation of legible and complete boring logs during drilling is necessary so that the borehole and geologic conditions are properly documented.

At a minimum, the following information will be documented on the boring log:

- Project name / Investigation name
- Supervising contractor name
- Boring identification number
- Start date and time
- End date and time

- Rig geologist name
- Drilling subcontractor and personnel
- Drill rig type
- Drilling method
- Bit diameter (and borehole diameter, if different)
- Auger external and internal diameter
- Sampling method
- Total depth of borehole recorded to the nearest 0.1 feet
- Ground surface elevation (recorded on log following surveying)
- Surveyed horizontal coordinates (recorded on log following surveying). If surveyed horizontal coordinates are not available at the time of drilling, location sketches referencing measured distances to prominent surface features (e.g., building corners, existing wells, fence corners) shall be recorded in the geologist's field log book.
- Sample depths or intervals recorded to the nearest 0.1 feet
- Blow counts
- Sample recovery
- USCS, ASTM or USDA classification for unconsolidated materials
- Rock type classification for consolidated materials
- Graphic representation of material
- Detailed lithologic description. For unconsolidated materials the description should address the parameters listed in Table 1, including compaction/consistency, water content, color, texture (grain sizes, sorting, and shapes) and plasticity, major and minor constituents (e.g., gravel, sand silt, clay), and major mineralogy (as identifiable from the sample). For rock materials the description should address the parameters listed in Table 2, including weathering classification, color, texture, hardness, rock type and major mineralogy, and presence and orientation of fractures, staining, and bedding.
- Stratigraphic/lithologic changes. Where distinct lithologic changes are directly observed, they will be identified on the boring log by a solid horizontal line. Gradational transitions and changes identified indirectly from cuttings or methods other than direct observation and measurement will be identified by a horizontal dashed line.
- Detailed description of basis for identification of top of weathered bedrock and top of unweathered bedrock.
- Depth at which water is first encountered, the depth of water at the completion of drilling, and the static depth to water (if possible). Static water level data will include time allowed for levels to stabilize. The absence of water in borings will also be indicated.
- Borehole field meter readings (e.g., PID, FID, CGI, radioactivity meter)
- Other drilling, sampling, and borehole observations as appropriate (e.g., resistant layers, typical or unusual odors, staining, or other indications of potential contamination)

4.2 FIELD LOGBOOK

In addition to the boring log, the geologist will also maintain a bound field logbook. The purpose of the field logbook is to document a semi-narrative record of the field conditions, activities, and events relevant to the field program on a daily basis. The field logbook constitutes the daily written record of the field activities, while the boring log constitutes the written record of the borehole conditions. The following information shall be recorded daily in the bound field logbook if approved field forms are not used:

- Arrival time at site
- Names and affiliations of personnel working at the drilling location
- Equipment used at the drilling location (drill rig, field screening equipment)
- Names of visitors to the drilling location
- Health and safety and field procedure briefings and attendees
- Weather conditions
- Chronological record of drilling and sampling activities documenting times and drilling subcontractor rates and material quantities
- Significant events, such as equipment breakdown, health and safety problems, drill crew standby
- Location and sample station number (including sketches showing measurements from prominent surface features (e.g., building corners, existing wells, fence corners)
- Sample documentation, disposition, and cross references to sampling forms and chain-of-custody records
- Decontamination activities
- Investigation Derived Waste handling activities
- Field screening instrument calibration information and measurements
- Other health and safety observations or concerns
- Significant deviations from the QAPP or SOPs
- Other applicable information
- Departure time from site

TABLE 1

LOG DESCRIPTORS FOR UNCONSOLIDATED SOIL

Parameter	Example
Depositional environment and formation, (if named and if known).	Alluvium; Piney Creek
Unified Soil Classification System and designation.	Clayey sand (SC), sandy clay (CL)
Secondary components and estimated quantities either by percentages or by descriptive percentage ranges (note: terms used to indicate ranges should be described on the log or in a general legend).	Sand: fine, with trace of med. trace gravel
Color. May use Munsel color chart.	Gray, brown, yellowish, 5YR 3/2, 5YR 4/4
Consistency (cohesive soil). Use relative term.	Very soft, soft, medium, stiff, very stiff, hard
Density (non-cohesive soil). Use relative term.	Loose, medium, dense, very dense
Moisture content. Use relative term. Do not express as a percentage unless a value has been measured.	Dry, damp, moist, wet, saturated
Texture/fabric/bedding	No apparent bedding, thinly bedded
Grain angularity	Rounded, subangular
Sorting (sands)	Poorly sorted, well graded
Grain or fragment size	Coarse, very fine
Mineralogical indicators	Quartz, feldspar grains
Note "fill", "top of natural ground", "top of weathered bedrock", and “top of unweathered bedrock” where appropriate	

TABLE 2

LOG DESCRIPTORS FOR CONSOLIDATED ROCK

Parameter	Example
Formation name (if known)	Denver Formation; Kootenai Formation
Rock type	Sandstone, shale, siltstone
Modifier denoting variety	Shaly, calcareous, siliceous, argillaceous, sandy, micaceous
Hardness	Very soft, soft, moderately hard, hard, very hard
Color	Medium brown, bluish-gray
Bedding	Parting band, thin bedded, medium bedded, thick bedded, massive, structureless, interbedded (Note: provide thickness range of each in legend)
Texture	Poorly cemented, well cemented, fine, coarse
Degree of weathering	Unweathered, intensely weathered
Degree of fracturing, fracture staining or filling	Highly fractured, limonite staining in fractures, MnO staining, calcite or zeolite fracture filling
Fracture orientation	Inclined 30º, horizontal
Structure and Orientation	Dipping beds at 10º
Mineralogical indicators	Andesite, volcanic grains, mafic minerals
Moisture content	Dry, damp, moist, wet, saturated

ATTACHMENT A

BORHOLE LOG FORM

SOIL BOREHOLE LOG

SITE NAME AND LOCATION:	DRILLING METHOD:	BORING NO.	
		SHEET ____ OF ____	
	SAMPLING METHOD	DRILLING	
		START	FINSH
NORTHING:	COMMENTS	TIME	TIME
EASTING: ELEVATION:		DATE	DATE
DRILL RIG	SURFACE CONDITIONS		
ANGLE BEARING			
SAMPLE HAMMER			

DEPTH IN FEET (ELEVATION)	Blow/ 6 in on sampler	RECOVERY	SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE	REMARKS
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						

DRILLING CONTRACTOR: ____

DRILLER NAME: ____

LOGGED BY: ____

CHECKED BY: ____

PROJECT NUMBER: ____

PROJECT NAME: ____

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List of Attachments

REVISION LOG		
Revision Number	**Description**	**Date**
0.0	Original SOP No. GW.105	01/23/12
1.0	QA Review and Update	03/01/12

ANNUAL REVIEW LOG		
Revision Reviewed	**Description**	**Date**
2.0	Annual QA Review	August 2013

1.0 PURPOSE

This Standard Operating Procedure (SOP) provides technical guidance and methods that will be used for the handling, management, and disposal of investigation derived waste (IDW) encountered or generated during environmental field activities. This SOP serves as a supplement to the investigation area-specific work plans and QAPPs, and is intended to be used with other activity-specific SOPs. IDW management personnel are also referred to *Management of Investigation-Derived Wastes During Site Inspections* (EPA 1991), *Guide to Management of Investigation-Derived Wastes* (EPA 1992) and applicable state and federal requirements.

2.0 REQUIREMENTS

The following sections identify the requirements for Quality Assurance / Quality Control (QA/QC), health and safety, and personnel qualifications for IDW management.

2.1 Quality Assurance / Quality Control

Follow all QA/QC requirements identified for the project as identified in the approved project planning document(s).

2.2 Health and Safety

Follow health and safety requirements identified in the Site-Specific Health and Safety Plan (HASP), Job Safety Analyses (JSAs), any applicable Task-Specific HASPs prepared by PWT Subcontractors, and the associated Activity Hazard Analyses (AHAs).

2.3 Personnel Qualifications

Personnel overseeing the handling and disposal of IDW will have IDW management knowledge and experience, or will work under the direct field supervision of knowledgeable and experienced personnel.

3.0 MATERIALS AND EQUIPMENT

The following materials and equipment may be needed for IDW management:

- Personal protective equipment (PPE) as outlined in the HASP
- Decontamination equipment and supplies (e.g., wash/rinse tubs, brushes, alconox, plastic sheeting, paper towels, sponges, baby wipes, garden-type water sprayers, large plastic bags (minimum 0.85 mil), potable water, distilled water and/or deionized water)
- Department of Transportation (DOT)-rated 55-gallon drums or other approved containers for containing soil cuttings, decontamination water, and formation water
- Drum/bung wrench and drum funnel
- Heavy equipment forklift or vehicle with drum grappler
- Laboratory-supplied sample containers
- Photoionization detector (PID) or flame ionization detector (FID)
- Wood pallets

- Non-porous (e.g., stainless steel) shovels
- Hazardous Waste Labels
- Soil roll-off bins with liners and covers (if warranted)
- Polyethylene tank (if warranted)
- Waterproof and permanent marking pens

4.0 PROCEDURES

Environmental field activities may generate IDW that poses a risk to human health and the environment. It is anticipated that both non-liquid and liquid IDW will be generated or encountered during environmental field activities.

Non-liquid IDW may include:

- Drill cuttings from soil borings
- Sludges (from soil borings in the saturated zone and from development water)
- Excavated soil from trenches
- Construction debris (e.g., concrete and asphalt)
- Buried landfill materials (e.g., burned wood, desks, and metal objects)
- PPE
- Disposable investigation equipment (i.e., bailers, twine, discarded sample bottles, preservative containers, paper towels, aluminum foil)
- Empty drums

Liquid IDW may include:

- Well development water
- Purge water (from monitor wells)
- Well abandonment water
- Decontamination water

4.1 Non Liquid IDW

4.1.1 Soil IDW

- Soil cuttings generated during drilling and soil sampling will be placed into DOT-rated 55-gallon drums, or appropriately sized containers at the point of generation.
- Mixing of the cuttings from several borings or sampling locations is permissible in order to fill the drums. The splitting of cuttings from one boring into several drums should be avoided.
- When drums are full, or daily activities are completed, the drum lids and rings will be fastened. Full drums will be transported to a designated IDW accumulation area on a regular basis to avoid

accumulation of drums at investigation sites for extended periods of time. Alternative temporary IDW accumulation areas can be used as specified in the investigation-specific work plan.

- If large volumes of soil IDW will be generated, soil IDW will be transferred from the drums into roll-off bins (lined and covered) located within the designated IDW accumulation area.
- If only a small volume of soil IDW will be generated, DOT-rated 55-gallon drums can be used for the temporary storage of soil IDW pending analysis. Drums will be stored on pallets at the designated IDW accumulation area. Drums from individual sites will be segregated from each other as much as possible. The drums will be sealed and labeled with permanent markings (using paint pens or drum labels) with the following information:
  1. Source: the boring(s), well, or site identification number
  2. Matrix (e.g., soil, water)
  3. Sample interval (e.g., 0–20 ft or well screen depth) (multiple drums of development or purge water will be numbered consecutively as they are filled)
  4. Fill date
  5. Drum identification number
  6. Contractor
  7. The EPA or PWT designee point of contact with phone number
  8. "Contents Pending Analysis"

Soil IDW in drums will typically be characterized and disposed of based on the characterization of associated investigation sample results (if collected and analyzed).

If no associated investigation sample results exist, a composite soil sample will be collected from the soil IDW drums by collecting a drive or hand auger sample from each of the drums associated with a specific field activity. The sample material from all of the drums will be composited into a single sample that will be used to characterized and dispose of the soil IDW.

4.1.2 Excavated Soil from Trenches

Most trenching operations will generate substantial volumes of excavated soil.

Large volumes of excavated soil IDW will be placed directly into roll-off bins (lined and covered) at the excavation site. This procedure will minimize concerns resulting from stock piling the soil IDW, such as wind dispersion and contamination of the ground surface.

- Small volumes of excavated soil can be placed in drums at the excavation site. Drums will be labeled and stored as described in Section 4.1.1.
- Soil IDW in drums will be sampled (if warranted), characterized, and disposed of as described in Section 4.1.1 above.

Soil IDW placed on the ground surface prior to placement into drums or roll-off bins, must be placed on plastic sheeting covering the ground surface. The soil IDW must be transferred to drums or roll-off bins before completion of the days activities.

4.1.3 Construction Debris and Landfill Material

- Small pieces of construction debris or landfill materials, that do not, and have not, contained controlled substances may be placed in the soil IDW roll-off bins or drums. For example, small amounts of wood, concrete, rebar, and paper do not require segregation from the soil IDW.
- Large volumes of the materials listed above, and large objects, such as desks or large metal objects, will be segregated separately from the soil IDW.
  - If the associated soil IDW is characterized as nonhazardous, these materials can be disposed of as nonhazardous solid waste.
  - If the associated soil IDW is characterized as hazardous, potential surface contamination will be removed from the large objects with nonporous surfaces by brushing off, or using small amounts of water to scrub off, gross potential contamination. After decontamination, these objects can be disposed of as nonhazardous solid waste.
  - If the associated soil IDW is characterized as hazardous, large objects with porous surfaces may require disposal as hazardous waste. Consult the IDW disposal contractor.
- Containers that may contain or potentially contained controlled substances (e.g., paint cans, drums) will be segregated from the materials described above and placed in appropriately sized containers.
  - Consult the IDW disposal contractor for the appropriate disposal requirements for these materials.

4.1.4 PPE and Disposable Investigation Equipment

- PPE and disposable investigation equipment will be segregated separately and placed in dedicated heavy duty (minimum 0.85 mil) plastic bags or containers (e.g., drums).
- Potentially contaminated PPE or disposable investigation equipment will be decontaminated prior to placement in the plastic bags or containers, if warranted.
- Decontamination procedures consist of brushing off, or using small amounts of water to scrub off, gross potential contamination.
- PPE and disposable investigation equipment that have been decontaminated, if warranted, are considered refuse and do not require characterization prior to disposal as nonhazardous solid waste.

4.2 Liquid IDW

- Well development, purge, abandonment, and decontamination water will be contained in DOT-rated drums, or appropriately sized water-tight containers, at the point of generation. When drums are full, or daily activities are completed, the drum lids and rings will be fastened, and the drums will be transported to the designated temporary IDW accumulation area as described in Section 4.2 of Attachment B. Alternative temporary IDW accumulation areas can be used as specified in the activity-specific work plan.
- If large volumes of water will be generated, the water will be transferred into an appropriately sized polyethylene tank. The liquid IDW in the polyethylene tank will be characterized based on the analytical results of the well or wells sampled, or from a representative grab sample collected from the tank. The sample will be collected using a colliwasa, disposable point source bailer, or bomb sampler for discrete interval sampling within the polyethylene tank.

- After analytical data for the liquid IDW are obtained from the laboratory, the data will be directly compared to the hazardous waste concentrations presented in Table 1 in 40 CFR §261.24 (Attachment A). The liquid IDW will then be removed, and treated and disposed of by a certified hazardous waste contractor in accordance with the applicable waste characterization (Section 5.0).
- If only a small volume of water IDW will be generated, DOT-rated 55-gallon drums can be used for the temporary storage of water IDW pending analysis. Water IDW drums will be labeled and stored as described in Section 1.1.1, Soil IDW above.
- Water IDW in drums will be characterized and disposed of based on the characterization of associated investigation sample results (if collected and analyzed).
- If no associated investigation sample results exist, a composite water sample will be collected from each of the water IDW drums associated with a specific field activity. The sample will be used to characterize and dispose of the water IDW.
- The list of chemicals to be analyzed for is the same as the list for soil characterization (Attachment A).

5.0 DOCUMENTATION

Project staff are responsible for thoroughly documenting IDW handling and disposal activities. IDW personnel will be responsible for documenting the collection, transportation, labeling (if applicable), and staging or disposition of IDW. The documentation will be recorded with waterproof ink on a Waste Inventory Tracking Form (Attachment A) or in the sampler's field notebook with consecutively numbered pages. The information entered concerning IDW should include the following:

- Project Name
- PWT and subcontractor personnel
- Site location
- Type of activities
- Date waste generated
- Boring, well, or site number(s)
- Matrix
- Type of container(s) and identification number(s)
- Estimated volume
- Disposition of contents (roll-off/location, tank/location, temporary staging area)
- Waste characterization
- Comments (field evidence of contamination [e.g., PID reading, odors])

ATTACHMENT A

Waste Inventory Tracking Form

WASTE INVENTORY TRACKING FORM

Project Name: ____

PWT and Subcontractor Personnel:____

Site Location: ____

Type of Activities:____

Date Waste Generated	Borehole, Well, or Site #	Matrix	Type of Container (Plus ID#, if applicable)	Estimated Volume	Disposition of Contents	Waste Characterization	Comments (Field Evidence of Contamination [e.g., PID reading, odors])

Signature:____

ATTACHMENT B

Maximum Concentration of Contaminants for the Toxicity Characteristic

Maximum Concentration of Contaminants for the Toxicity Characteristic

EPA Hazardous Waste Number	Contaminant	Regulator Level (mg/L)
D004	Arsenic	5.0
D005	Barium	100.0
D018	Benzene	0.5
D006	Cadmium	1.0
D019	Carbon tetrachloride	0.5
D020	Chlordane	0.03
D021	Chlorobenzene	100.0
D022	Chloroform	6.0
D007	Chromium	5.0
D023	o-Cresol	(1) 200.0
D024	m-Cresol	(1) 200.0
D025	p-Cresol	(1) 200.0
D026	Cresol	(1) 200.0
D016	2,4-D	10.0
D027	1,4-Dichlorobenzene	7.5
D028	1,2-Dichloroethane	0.5
D029	1,1-Dichloroethylene	0.7
D030	2,4-Dinitrotoluene	0.13
D012	Endrin	0.02
D031	Heptachlor (and its epoxide)	0.008
D032	Hexachlorobenzene	0.13
D033	Hexachlorobutadiene	0.5
D034	Hexachloroethane	3.0
D008	Lead	5.0
D013	Lindane	0.4
D009	Mercury	0.2
D014	Methoxychlor	10.0
D035	Methyl ethyl ketone	200.0
D036	Nitrobenzene	2.0
D037	Pentachlorophenol	100.0
D038	Pyridine	5.0
D010	Selenium	1.0
D011	Silver	5.0
D039	Tetrachloroethylene	0.7
D015	Toxaphene	0.5
D040	Trichloroethylene	0.5
D041	2,4,5-Trichlorophenol	400.0
D042	2,4,6-Trichlorophenol	2.0
D017	2,4,5-TP (Silvex)	1.0
D043	Vinyl chloride	0.2

Notes:
(1)If o-, m-, and p- Cresol concentrations cannot be differentiated, the total cresol (DO26) concentration is used. The regulatory level of total cresol is 200 mg/L.
Source: 40 CFR 261.24 and WHWRR, Chapter 2, Section 3 (e)(ii).

PWT STANDARD OPERATING PROCEDURE

APPROVED: ______________________ September 27, 2013
PWT Project Manager, Greg Hayes Date

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REVISION LOG		
Revision Number	**Description**	**Date**
1.0	Original SOP	July 2011
2.0	QA Review and Update	March 2012

ANNUAL REVIEW LOG		
Revision Reviewed	**Description**	**Date**
2.0	Annual QA Review	August 2013

1.0 PURPOSE AND SCOPE

This Standard Operating Procedure (SOP) provides technical guidance and methods that will be used to conduct decontamination of personnel and investigation equipment during environmental investigations. This SOP serves as a supplement to site-wide and investigation area specific workplans and the site-specific Quality Assurance Project Plan (QAPP) and may be used in conjunction with other SOPs.

2.0 REQUIREMENTS

The following sections identify the requirements for Quality Assurance / Quality Control (QA/QC), health and safety, and personnel qualifications for personnel and equipment decontamination.

2.1. Quality Assurance / Quality Control

Follow all QA/QC requirements identified for the project as identified in the approved project planning document(s).

2.2. Health and Safety

Follow health and safety requirements identified in the Site-Specific Health and Safety Plan (HASP), Job Safety Analyses (JSAs), any applicable Task-Specific HASPs prepared by PWT Subcontractors, and the associated Activity Hazard Analyses (AHAs).

2.3. Personnel Qualifications

Personnel overseeing and performing decontamination activities will have knowledge and experience in the equipment and methods proposed, or will work under the direct field supervision of knowledgeable and experienced personnel.

3.0 MATERIALS AND EQUIPMENT

The following materials and equipment may be needed for personnel and equipment decontamination:

- Monitoring equipment and personal protective equipment (PPE) as outlined in the HASP.
- Decontamination equipment and supplies (e.g., wash/rinse tubs, nitrile disposable gloves, brushes, Alconox, plastic sheeting, paper towels, sponges, baby wipes, garden-type water sprayers, large plastic bags, potable water, distilled water and/or deionized water
- High pressure washer/steamer
- Four-foot long capped PVC casing for decontamination of submersible pumps
- Drums or other approved water-tight containers for containing decontamination sediment and fluids
- Materials necessary to construct an investigation site-specific decontamination facility, if required (e.g., heavy plastic sheeting, berming materials, sump pump, water tanks, roll-off bins)

4.0 PROCEDURES

This procedure describes the method for physically removing contaminants. It applies to chemical and radioactive decontamination of personnel and equipment used in field investigations. All equipment must be decontaminated before use at the project site, prior to sample collection, and before being removed from the project site. Decontamination of personnel, sampling equipment (e.g., soil sampling equipment and submersible pumps) and heavy equipment (e.g., hollow stem auger rigs, backhoes) is required to ensure the health and safety of personnel, reduce the potential for sample cross-contamination, and reduce the potential for contamination to enter or leave the project site on personnel or equipment.

4.1 Decontamination

4.1.1 Location of Decontamination Activities

Decontamination activities may take place either in the exclusion zone of the investigation site or at a decontamination facility designed to contain larger volumes of potentially contaminated fluids and materials, or at a combination of the two. Decontamination activities conducted in the exclusion zone will be limited to washing of personnel and small sampling equipment using wash tubs or wipes. Scraping of PPE and large equipment to remove adhered clumps of soil will also be performed in the exclusion zone.

Decontamination of heavy equipment or equipment requiring high-pressure washing will be performed at a decontamination facility designed to contain large volumes of washing fluids. The decontamination facility may consist of an investigation area-specific temporary facility constructed near the investigation site, or a decontamination facility central to the project site that may be used for multiple investigations. If a central decontamination facility is used, sufficient decontamination of equipment will be performed in the exclusion zone prior to moving to the central facility to reduce the potential for deposition of contaminated materials on roadways between the investigation area and decontamination facility.

Decontamination facilities will be constructed to limit the potential for contact of potentially contaminated materials (decontamination sediment and fluids) with environmental media (i.e., soil or water) in the decontamination area. This will be accomplished by performing decontamination activities in lined and bermed areas, and by containing decontamination sediment and fluids as they are generated.

4.1.2 Personnel Decontamination

The following steps will be used to perform personnel decontamination:

- Soil adhering to boots, apparel and equipment will be scraped off at the sampling or excavation site.
- Boots and outer apparel that will not be damaged by water will be washed with Alconox low-sudsing detergent and potable water and scrubbed with a bristle brush or similar utensil (if possible). Apparel will be rinsed with potable water.
- Coveralls removed (if used).
- Hard hat and other safety equipment removed and washed with Alconox and rinsed with potable water.
- Gloves and respirator (if used) removed.
- Personnel shall wash hands, face, and forearms before eating/drinking.
- Following decontamination, apparel will be placed in a clean area, on clean plastic sheeting to prevent contact with contaminated soil. If the apparel is not used immediately, the equipment will be stored in plastic sheeting or heavy duty trash bags.

- Disposable PPE will be handled in accordance with Section 4.1.1 of the PWT Investigation Derived Waste Management SOP.

4.1.3 Small Sampling Equipment Decontamination

Small sampling equipment consists of split spoons, sample bowls, scoops, hand augers, filtering devices, non-dedicated pumps, water level meters, and other such small equipment used in the exclusion zone or the immediate vicinity of the sample collection location. Small sampling equipment is designed to be decontaminated at the sampling location using small wash tubs. Decontamination of small sampling equipment does not require high-pressure washing or steam cleaning, or result in production of large volumes of decontamination sediment or fluids.

The following steps will be used to decontaminate small sampling equipment:

- To reduce personal exposure, personnel will dress in suitable PPE in accordance with the HASP.
- Soil adhering to equipment will be scraped off at the sampling site and containerized.
- Equipment that will not be damaged by water will be placed in a wash tub containing Alconox or equivalent detergent and potable water and scrubbed with a brush. Equipment will then be rinsed initially with potable tap water and then with distilled water.
- Equipment that cannot be submerged in water (e.g., air monitoring devices, electronic devices) will be carefully wiped clean using a sponge and detergent water or baby wipes.
- Wash and potable rinse water should be replaced frequently. Decontamination sediment and water will be handled as investigation derived waste (IDW) (see Section 4.1.6).
- Disposable sampling equipment will be handled in accordance with PWT's Investigation Derived Waste Management SOP.

Following decontamination, equipment will be placed in a clean area or on clean plastic sheeting. If the equipment is not used immediately, the equipment will be covered or wrapped in plastic sheeting or trash bags.

4.1.4 Decontamination of Submersible Pumps

Submersible pumps used to conduct groundwater sampling will be decontaminated before being placed in the well. A decontaminated four-foot length of polyvinyl chloride (PVC) capped on one end will be utilized for this procedure. The following steps will be used to decontaminate submersible pumps:

- To reduce personal exposure, personnel will dress in suitable PPE in accordance with the HASP.
- Scrub the outside of the pump with a solution of Alconox or equivalent detergent and potable water and then rinse with potable water and distilled water.
- Fill the PVC tube with Alconox/potable water solution.
- Pump the solution through the submersible pump by lowering the intake tube of the pump to the bottom of the PVC tube. Be careful not to uncover the intake of the pump to prevent damage to the pump.
- Rinse the inside of the PVC tube with potable water to remove detergent and then fill the PVC tube with potable water.
- Pump the potable water through the pump.
- Repeat the rinse procedure with distilled water.

- Decontamination sediment and water will be handled as IDW (see Section 4.1.6 below).

Following decontamination, the pump will be wrapped in plastic sheeting or trash bags and placed in a clean area.

4.1.5 Heavy Equipment Decontamination

Heavy equipment used within the exclusion zone and/or for intrusive activities (e.g., drill rigs and associated heavy drilling and sampling equipment, backhoes, sampling-related vehicles) will be decontaminated upon arrival at the project site, between investigation locations (i.e., between boreholes and test pits), and prior to leaving the project site. The following steps will be used to decontaminate heavy equipment:

- To reduce personal exposure, personnel will dress in suitable PPE in accordance with the HASP.
- Prior to use at the project site and between investigation locations (i.e., between boreholes, test pits), the portion of the equipment directly exposed to potential contamination (e.g., augers, drill rods, backhoe bucket) will be decontaminated by pressure washing the equipment at the decontamination facility.
- Drill rigs and vehicles will not require pressure washing between investigation locations unless they have become substantially dirty as a result of drilling or investigation activities.
- Prior to leaving the project site, the portions of the heavy equipment potentially exposed to contamination will be pressure washed using potable water at the decontamination facility. Special attention will be given to removing any soil or other site-related foreign materials on the equipment.
- Decontamination sediment and water will be handled as IDW as described in Section 4.1.6 below.

4.1.6 Decontamination Sediment and Fluids

Sediment and fluids from decontamination activities will be initially contained and stored in approved water-tight containers at the sampling site or decontamination facility. Each container will be labeled with its contents and the date using a paint pen, or permanent marker. As soon as practical, decontamination sediment and fluids will be transferred from the sampling site to a designated IDW management area. Handling of IDW is addressed by PWT's Investigation Derived Waste Management SOP.

4.2 Equipment Rinsate Sampling

Equipment rinsate blank samples may be collected to verify the effectiveness of the decontamination procedures. Equipment rinsate blank sampling is usually performed for small sampling equipment, rather than heavy equipment. The frequency of rinsate blank sample collection, as well as the analysis methods, will be specified in the investigation-specific QAPP. In general, the rinsate blank sample collection procedure will consist of rinsing decontaminated equipment with laboratory-grade deionized water and collecting the rinsate water in sample bottles provided by the analytical laboratory. Special attention will be given to rinsing the portions of the equipment exposed to environmental samples or potential contamination. Rinsate samples will be handled in the same manner as environmental and other QA/QC samples in accordance with PWT's Sample Handling SOP. Rinsate sample collection will be documented in the same manner as environmental and other QA/QC samples.

5.0 DECONTAMINATION DOCUMENTATION

Field personnel will be responsible for documenting proper sampling equipment and heavy equipment decontamination. The purpose of documentation is to demonstrate in the written field record that decontamination was performed in accordance with this SOP. Decontamination activities will be documented at least each day they are performed. The documentation will be recorded in a logbook or on appropriate project forms (i.e., boring log, sample field data sheets). The information recorded concerning decontamination will include:

- Date and times of decontamination
- Location of decontamination activities (i.e., sample site, central decontamination facility)
- Decontamination personnel and materials
- Decontamination steps/observations
- Other applicable information

PWT STANDARD OPERATING PROCEDURE

TABLE OF CONTENTS

List of Attachments

REVISION LOG		
Revision Number	**Description**	**Date**
0.0	Original SOP	June 2012
1.0	Edits to Section 4.2 Composite Samples	September 2013
2.0	Addition of Section 4.3 Rinsate Blanks	May 2014

ANNUAL REVIEW LOG		
Revision Reviewed	**Description**	**Date**

0.0	Annual QA Review	August 2013

1.0 PURPOSE AND SCOPE

This Standard Operating Procedure (SOP) provides technical guidance and methods that will be used to collect surface soil samples for chemical analysis during environmental investigations. This SOP serves as a supplement to site-specific work plans and the site-specific Quality Assurance Project Plan (QAPP). This SOP may be used in conjunction with other SOPs. This SOP is not appropriate for sampling to determine concentrations of organic compounds.

The SOP describes procedures for collection of discrete samples (i.e., samples collected at a single point for chemical analysis), and composite samples (i.e., composed of multiple increment samples collected at several points within the area to be characterized) at multiple depths in 6 inch increments up to 24 inches (0-6", 6-12", 12"-18" and 18"-24"). Unless otherwise specified by the QAPP, the term "surface soil" refers to the top 24 inches of soil following removal of surface vegetation and other debris from the sampling area. Sample collection depths other than the ranges given may be specified by the QAPP.

2.0 REQUIREMENTS

The following sections identify the requirements for Quality Assurance / Quality Control (QA/QC), health and safety, and personnel qualifications for surface soil sampling.

2.1. Quality Assurance / Quality Control

Follow all QA/QC requirements identified for the project as specified in the approved project planning documents.

2.2. Health and Safety

Follow health and safety requirements identified in the Site-Specific Health and Safety Plan (HASP), Job Safety Analyses (JSAs), any applicable Task-Specific HASPs prepared by PWT Subcontractors, and the associated Activity Hazard Analyses (AHAs).

A walkthrough shall be performed to identify any site specific hazards. Site specific hazards may include but are not limited to unidentified utilities such as underground propane lines, septic system drainfields, sprinkler systems, and owner placed electrical lines. Utility clearance will have been accomplished according to the PWT Utility Clearance SOP. Other site specific hazards may include low tree limbs, unleashed animals, ponds, and miscellaneous equipment.

2.3. Personnel Qualifications

Personnel performing surface soil sampling are required to have completed the initial 40-hour OSHA classroom training that meets the Department of Labor requirements 29 CFR 1910.120(e)(3)(i), and must maintain a current training status by completing the appropriate annual 8-hour OSHA refresher courses. Personnel must also have read and signed the appropriate HASP(s). Prior to engaging in surface soil sampling activities, personnel must have a complete understanding of the procedures described within this SOP and, if necessary, will be given specific training regarding these procedures by other personnel experienced in the methods described within this SOP.

Only qualified personnel will be allowed to perform these procedures. Required qualifications vary depending on the activity to be performed. If work is being performed by a subcontractor, the subcontractor's project manager will document personnel qualifications related to this procedure in the subcontractor's project QA files.

3.0 MATERIALS AND EQUIPMENT

The following materials and equipment may be necessary for surface soil sampling:

- Laboratory-supplied sample containers
- Nitrile disposable gloves
- Bound field logbook
- Sampling site location maps
- 100-foot tape measure
- Measuring device such as small tape measure or calibrated instrument to identify sample hole depth increments
- Soil sample field data sheets (Attachment A)
- Approximate 3’ by 3’ plastic sheeting
- Surveying stakes or flags for marking of grid nodes and/or sampling locations
- Monitoring equipment and personal protective equipment (PPE) as outlined in the HASP
- Decontamination equipment and supplies (e.g., high pressure sprayer/washer, wash/rinse tubs, brushes, Alconox (or equivalent), plastic sheeting, paper towels, sponges, baby wipes, garden-type water sprayers, large plastic bags, potable water, and deionized water)
- Stainless steel scoops or spoons, knives, pick, and mixing bowls identified for each interval sample to be collected. Each bowl shall be clearly labeled for the sample depth range.
- Plastic or wooden ruler or graduated wooden survey lathe for measuring depth of holes
- Decontaminated drive sampler device with stainless steel liners
- Sledgehammer or slide hammer drive device
- Stainless steel shovels, breaker bars, picks for digging sample holes, (supplies may have to be purchased from an environmental supplier)
- Jackhammer with stainless steel (not carbon steel) bit, for hard soils, if allowed by the QAPP
- Sample collection supplies (e.g., plastic recloseable plastic bags or equivalent, waterproof markers, sample labels, chain of custody [COC] forms, cooler for sample storage, ice or ice substitute, clear plastic and strapping tape, custody seals, trash bags)
- Drums or other approved containers for containing investigation derived waste (IDW) soil and water

Other materials and equipment may be needed based on field conditions.

4.0 PROCEDURES

4.1 Discrete Samples

Discrete samples consist of samples collected for chemical analysis from a single location.

Sampling sites specified in the QAPP will be located and marked using surveying stakes, lath, or flags. Discrete surface soil samples will be collected as follows:

1. Place plastic sheeting in close proximity to the proposed sample hole. At each location, clear an area approximately 12 inches in diameter of surface vegetation and debris by cutting the shape of the sample hole through the vegetative mat with available shovel and/or handtools. The cleared vegetative material shall be removed as a mat and lose soil particles removed by shaking over the stainless steel container designated for the upper sample range. In the absence of vegetative cover (e.g. gravel driveway) proceed with Step 2.

2. Dig a 12 inch diameter hole to the required depth specified in the QAPP. Place measuring device inside hole and mark distinct sample ranges (surface to 6”, 6”-12”, etc.). Place soil material removed from the hole on the plastic sheeting in the order it was removed from the hole.

3. Use a decontaminated stainless steel spoon to collect the soil at the designated depths. Samples should be taken from the deepest sampling point first to minimize cross contamination from loose sample soil from upper sample points. The next sample point should be the next sample range up from the bottom of the sample hole. The process should be repeated until the top sample range has been sampled. A steel pick may be used as needed to loosen the soil. To the extent possible, eliminate gravel size or larger particles or debris based on visual observation. Be sure to collect sufficient sample volume to meet analytical requirements.

4. Place the remainder of the sample in a stainless steel bowl. To the extent possible, eliminate gravel size or larger particles or debris based on visual observation.

5. If the sample is to be homogenized, thoroughly mix the sample material in the stainless steel bowl using a decontaminated stainless steel spoon. To homogenize, divide the sample into four quarters and mix each quarter, then combine the four quarters and mix the entire sample.

6. Immediately fill the appropriate sample containers. Label and handle the containers as specified in the PWT Sample Handling SOP.

7. Decontaminate the sampling equipment in accordance with the PWT Personnel and Equipment Decontamination SOP.

An alternate method for collection of discrete surface soil samples involves the use of a decontaminated drive sampler with stainless steel liners. Because only one 6-inch liner can be filled at a drive location, this method may require several drives at adjacent locations to obtain the necessary volume of sample material to meet typical analysis requirements. This procedure will have to be repeated for each sample range to the full sample depth required.

1. Clear the sampling area, as per Step 1 above.

2. Using a sledgehammer or slide hammer drive device, drive a decontaminated drive sampler or other appropriate device containing stainless steel liners into the ground to the depth required by the QAPP. The process should be repeated at each drive location to obtain the required sample for the required sample depth.

3. Remove and open the sampler.

4. Log the sample in accordance with the PWT Borehole Logging SOP, if required by the project-specific QAPP.

5. Drive additional samples at adjacent locations to collect sufficient material for the analyses by repeating steps 1 through 5. Extrude the sample material from each liner for analysis into a decontaminated stainless steel bowl.

6. Once all the soil material is collected, thoroughly mix the soil sample material in the stainless steel bowl using a decontaminated stainless steel spoon. To homogenize, divide the sample into four quarters and mix each quarter, then combine the four quarters and mix the entire sample.

7. Immediately fill the appropriate sample containers. Label and handle the containers as specified in the PWT Sample Handling SOP.

8. Decontaminate the sampling equipment in accordance with the PWT Personnel and Equipment Decontamination SOP.

4.2 Composite Samples

Composite samples are comprised of multiple increment samples collected at several points. All or a portion of the increment samples are mixed together to create a composite sample representative of average constituent concentrations within the area to be characterized.

Prior to sampling, it is important to calculate the required volume of sample material to be collected at each increment sample location to ensure that the necessary amount of composite sample will be obtained. Required volumes of composite samples are analysis-specific and will be specified in the QAPP. For a given composite sample, the volume of each increment sample must be the same, and must equal 1/n of the required composite sample volume, where n equals the number of increment samples making up the composite sample.

Increment sampling locations specified in the QAPP will be laid out and marked using surveying stakes, lath, or flags. This typically involves staking a 5 point “star” pattern for 5 incremental sampling locations for an area, but may involve laying out a rectangular grid of points. The method for selecting incremental sampling locations will be described in the QAPP. Each composite surface soil sample will be collected as follows:

1. Place plastic sheeting in close proximity to the proposed sample hole. At each location, clear an area approximately 12 inches in diameter of surface vegetation and debris by cutting the shape of the sample hole through the vegetative mat with available shovel and/or handtools. The cleared vegetative material shall be removed as a mat and lose soil particles removed by shaking over the stainless steel container designated for the upper sample range. In the absence of vegetative cover (e.g. gravel driveway) proceed with Step 2.

2. Dig a 12 inch diameter hole to the required depth specified in the QAPP. Place measuring device inside hole and mark distinct sample ranges (surface to 6", 6"-12", etc.). Place soil material removed from the hole on the plastic sheeting in the order it was removed from the hole. Use a decontaminated stainless steel spoon to collect surface soil to a depth of 24 inches. A steel pick may be used as needed to loosen the soil. To the extent possible, eliminate gravel-size or larger particles and debris based on visual observation. **Important: Be sure to collect a sufficient volume of increment sample. The volume of increment sample collected at each location must be the same.**

3. Place the increment sample into a decontaminated stainless steel mixing bowl. Mix thoroughly.

4. Repeat Steps 1 through 3 at each increment sample location for a given composite sample, adding each successive increment sample to the stainless steel bowl.

5. Thoroughly mix the sample material in the stainless steel bowl with the stainless steel spoon used to collect all increment samples from that depth interval. To homogenize, divide the sample into four quarters and mix each quarter, then combine the four quarters and mix the entire sample. Place mixture into appropriate laboratory-supplied sample containers.

6. Decontaminate the sampling equipment in accordance with PWT's Personnel and Equipment Decontamination SOP.

7. Label and handle the containers as specified in the PWT Sample Handling SOP.

4.3 Equipment Rinsate Sampling

Equipment rinsate blank samples may be collected to verify the effectiveness of the decontamination procedures. Equipment rinsate blank sampling is usually performed for small sampling equipment, rather than heavy equipment. The frequency of rinsate blank sample collection, as well as the analysis methods, will be specified in the investigation-specific FSP. In general, the rinsate blank sample collection procedure will consist of rinsing decontaminated equipment with laboratory-grade deionized water and collecting the rinsate water in appropriate sample bottles. Special attention will be given to rinsing the portions of the equipment exposed to environmental samples or potential contamination. Rinsate samples will be handled in the same manner as environmental and other quality assurance/quality control (QA/QC) samples in accordance with PWT's Sample Handling SOP. Rinsate sample collection will be documented in the same manner as environmental and other QA/QC samples.

5.0 DOCUMENTATION

Personnel collecting samples are responsible for documenting sampling activities in the field logbook and on the Surface Soil Sample Field Data Sheet (Attachment A). Discussions of sample documentation are provided in the PWT Sample Handling SOP and the Borehole Logging SOP.

ATTACHMENT A

Surface Soil Sample Field Data Sheet

Surface Soil Sample Field Data Sheet

Inorganic Soil Sampling Field Form

Page 1 of ____

Project Information

Project Name:____

Contractor:____________________ Sample Technician(s):____________________

Location Information

Location Identification Number:____

Property Owner: ____

Property Address: ____

Weather:____

Time of Arrival:____________________ Time of Departure:____________________

****

Sample Information

Sample Identification Number:____

Property Subarea Identification or Description: ____

Sample Collection Method (circle one):

Spoon/Scoop/Trowel Drive Sampler Backhoe Other:______________

If Drive Sampler, identify liners used:____

Sample Location Recorded (circle one): GPS Survey Field Sketch Other:______________

Sample Type (circle one): Discrete Composite

Sample Homogenized (circle one): Yes No

Total Sample Volume:______________ measurement units__________________

Sample Depth:____________________ measurement units__________________

Sample Container: 4 oz glass jar 8 oz glass jar double Ziptop bagged Other:______________

Number of Sample Containers:________ Preservative: $4^{o}C \pm 2^{o}C$ Other:______________

Analyses:____

Sample Date:____________________ Sample Time:____________________

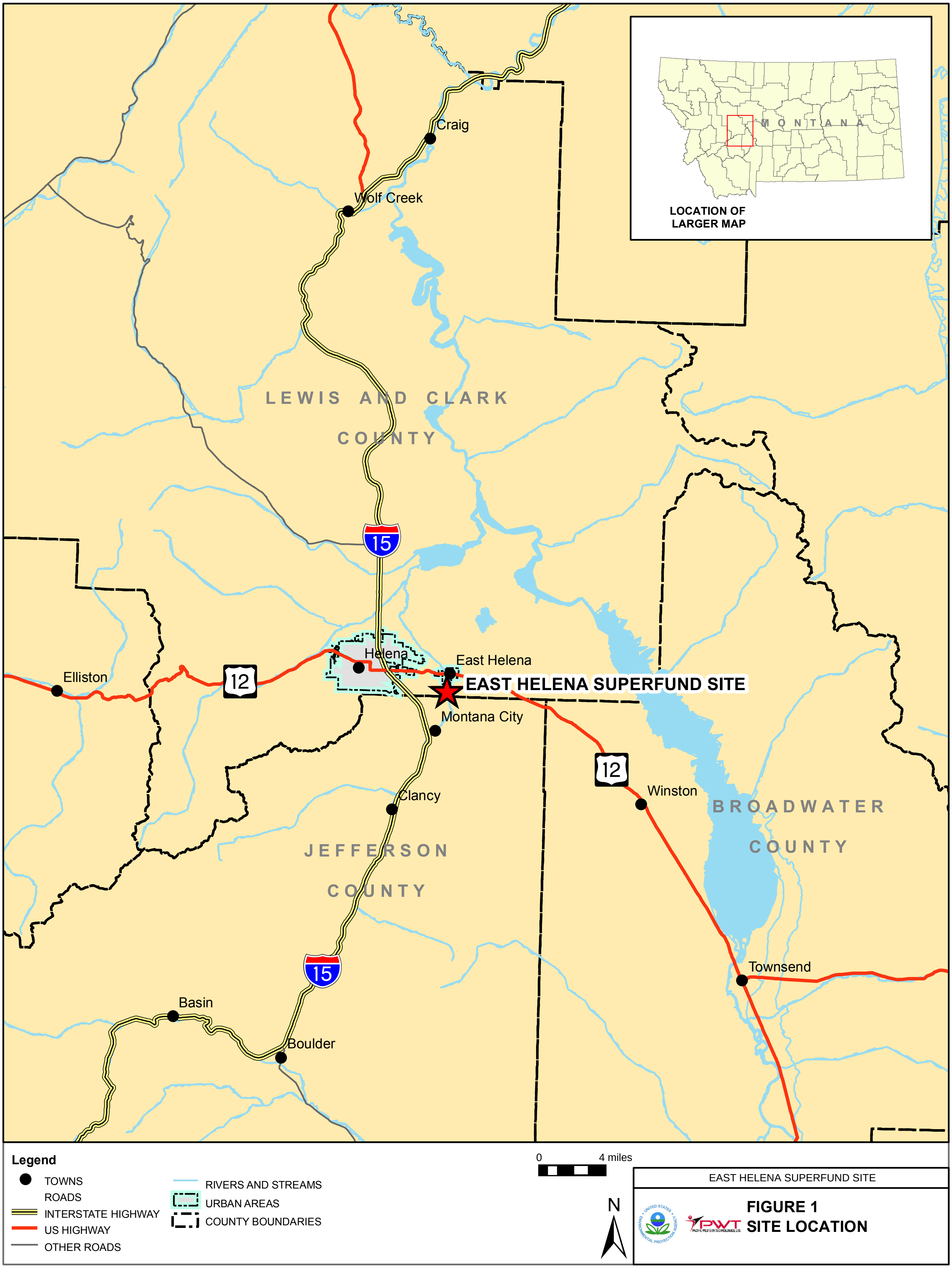
Associated QA/QC Sample Numbers:____

Comments/Observations:____

Samplers Name and Signature:____

Aliquot	Cover	Soil Type	Volume of Sample Recovered (note units)
1			
2			
3			
4			
5			

FIGURES



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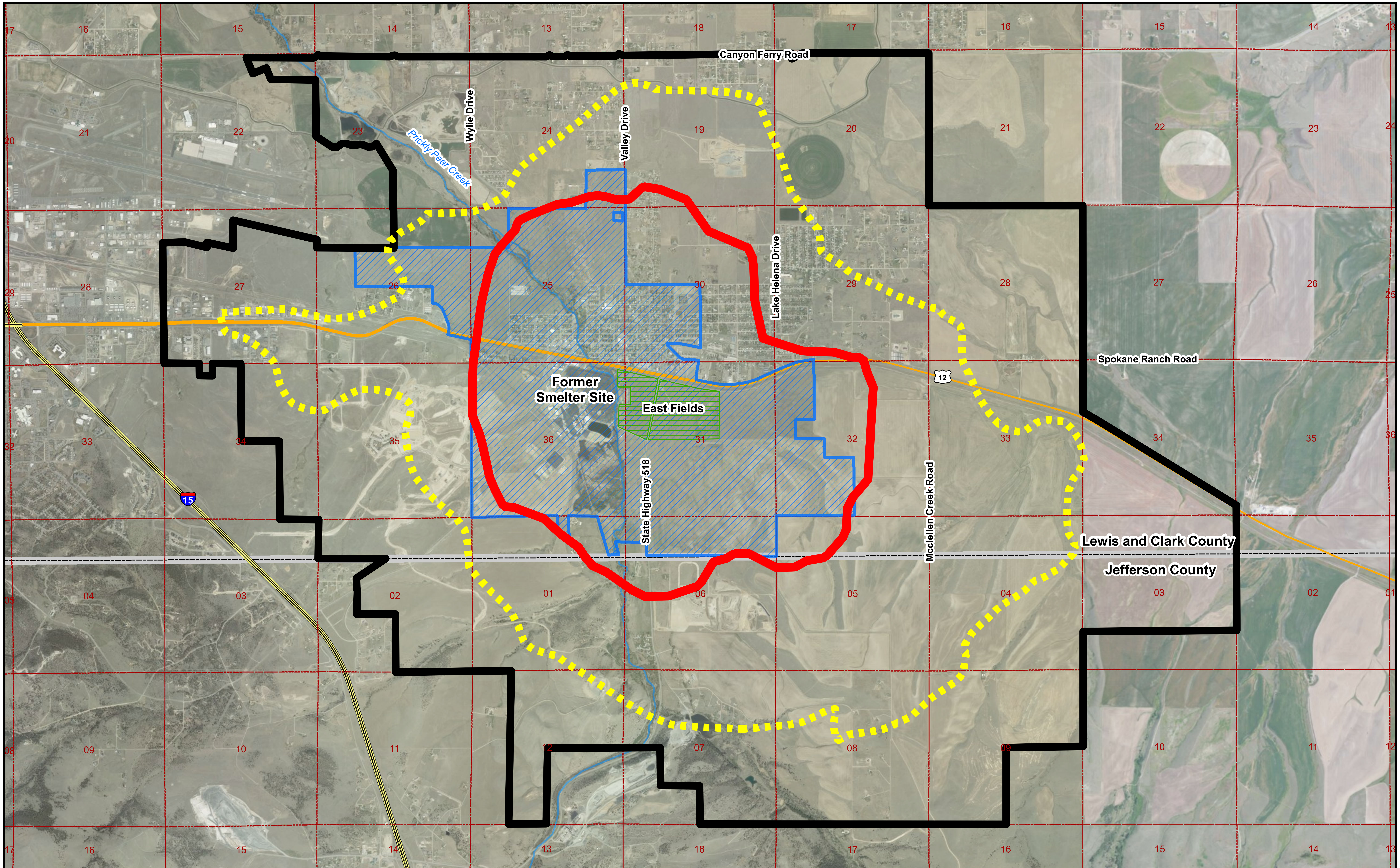

Legend

Estimated Distribution of Total Soil Lead - 500 mg/kg[1]
Estimated Distribution of Total Soil Lead - 1000 mg/kg[1]
OU2 Administrative Boundary[2]
East Helana City Limits
Township - Sections
East Fields
Interstate Highway
US Highway
County Boundaries
Rivers and Streams

0 0.25 0.5 1 Miles

N

1 - Estimated Distribution of Total Soil Lead lines based on EPA's 2009 Record of Decision
2 - OU2 is made up of Residential Soil and Undeveloped Lands not on Montana Environmental Trust Group land (except Lamping Fields, the Dartman parcel, and East Fields east of State Highway 518 which are all included in OU2)

East Helena Superfund Site

PWT PACIFIC WESTERN TECHNOLOGIES, LTD.

Figure 2 - Site Layout

Path: H:\ENSE\RAC2\132 East Helena RD\GIS\Figure 2_SiteLayout.mxd

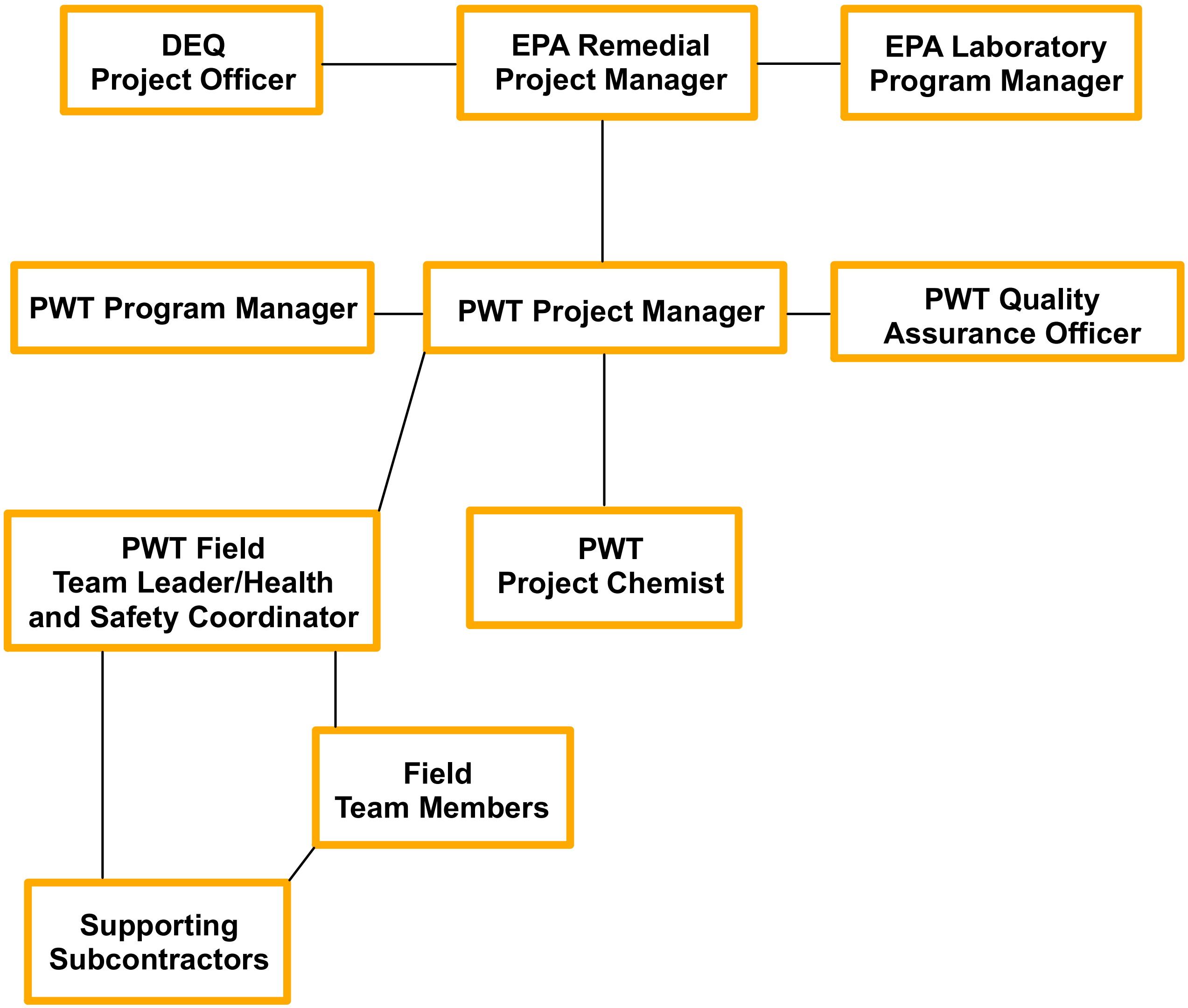

Figure 3

Organizational Chart

East Helena Superfund Site - OU2
Soil Sampling Program
Quality Assurance Project Plan
June 2014

EPA United States Environmental Protection Agency

DEQ Montana Department of Environmental Quality

PWT Pacific Western Technologies (Remedial Design Contractor) and Tetra Tech team members

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TABLES

Table 1
Personnel Responsibilities and Quality Assurance Project Plan Receipt
East Helena OU2 RD Soil Sampling
Quality Assurance Project Plan

Name	Organization/Affiliation	Project Responsibilities	Contact Information (phone, fax, email)	Quality Assurance Plan Receipt/Control Number
Betsy Burns	Environmental Protection Agency	Remedial Project Manager	406-457-5013 (fax) 406-457-5056 Burns.Betsy@epa.gov	Rev 0 September 27, 2013 Rev 1 May 5, 2014 and June 9, 2014
Daryl Reed	Montana Department of Environmental Quality	Project Officer	406-841-5041 (fax) 406-841-5050 dreed@mt.gov	
Gregory Hayes	Pacific Western Technologies, Ltd.	Project Manager Oversight Contractor	406-457-5495 (fax) 406-447-4255 greg.hayes@pwt.com	
Gregory Hayes	Pacific Western Technologies, Ltd.	Field Team Leader	406-457-5495 (fax) 406-447-4255 greg.hayes@pwt.com	
Robin Witt	Pacific Western Technologies, Ltd.	Quality Assurance Officer	303-274-5400 ext. 35 (fax) 303-274-6160 rwitt@pwt.com	
Deborah Kutsal	Tetra Tech	Project Chemist	509-688-5957 (fax) 509-744-9281 Deborah.kutsal@tetratech.com	

Table 2- Sample and Analysis Table
East Helena OU2 RD Soil Sampling
Quality Assurance Project Plan

Matrix	Analysis	Anticipated Concentration Range[1]	Laboratory Reporting Limits	Action Levels	Laboratory	Analytical Method	Sample Type	Replicates & MS/MSD	Sample volume	Sample Preservation/ Holding Times	Container Size/Type	Total Number of Analyses
Soil	Arsenic	13 - 3,179 ppm	1 ppm	FSP	EPA CLP	EPA Method 6010, ICP - AES	composite	1 each per 20 investigative samples	8 oz.	Cool to 4° C (±2° C) immediately after collection/6 months	One 8 oz short, wide mouth, straight-sided, glass jar	FSP
	Lead	15 - 27,304 ppm	1 ppm	FSP	EPA CLP	EPA Method 6010, ICP - AES	composite					FSP
Water (rinsate blanks only)	Arsenic	NA	10 ppb	NA	EPA CLP	EPA Method 6010, ICP - AES (200.7)	grab	NA	1 L	Acidify to pH < 2 with HNO3 and cool to 4° C (±2° C) immediately after collection, DO NOT FREEZE/14 days	1 L HDPE, cylinder-round bottle, 28 mm neck finish	FSP
	Lead	NA	10 ppb	NA	EPA CLP	EPA Method 6010, ICP - AES (200.7)	grab					FSP

1 Values taken from EPA/LEAP historical database from East Helena OU2
ICP-AES - Inductively Coupled Plasma-Atomic Emission Spectroscopy
ppm - parts per million
ppb - parts per billion
MS - matrix spike
MSD - matrix spike duplicate
EPA CLP - EPA Contract Laboratory Program
NA - not applicable
FSP - to be detailed in each activity-specific Field Sampling Plan

Table 3 - Field Equipment and Supplies List
East Helena OU2 RD Soil Sampling
Quality Assurance Project Plan

Item	Supply Source	Rental/Purchase	Quantity [1]	Storage Requirements
Ziplock quart Freezer bags (for samples)	local super market	P	700	Store in dry conditions
Ziplock gallon Freezer bags (for ice)	local super market	P	500	Store in dry conditions
Nitrile Gloves	grainger.com	P	30	None
Spray Bottle	homedepot.com	P	4	None
Decon brush	homedepot.com	P	4	None
Shipping Cooler	walmart	P	10	None
Decon sprayer	grainger.com	P	2	None
Decon 5 gallon bucket	homedepot.com	P	5	None
Alconox- 1 gallon container	grainger.com	P	3	Store in dry conditions
Paper towels	homedepot.com	P	10	Store in dry conditions
Deionized water - 5 gallon container	Culligan, Helena	P	10	Do not allow to freeze
Measuring Wheel	grainger.com	P	1	None
Engineering tape	grainger.com	P	2	None
Sampling Spade	homedepot.com	P	4	None
Stainless Hand Trowel	homedepot.com	P	4	None
Stainless Steel Bowls and Spoons	grainger.com	P	4	None
Munsell Color chart	PWT	NA	1	Protected from moisture and weather
Blank Sample Labels	PWT	P	Batch	None
Utility knife	homedepot.com	P	2	None
8 oz. wide mouth glass sample jars	ESS	P	700	None
1 L HDPE cylinder-round bottles (for rinsate blanks	ESS	P	40	Protected from moisture and weather
Wooden measuring stick	homedepot.com	P	4	None
Golf tees to mark sample depths	homedepot.com	P	1000	None
Digital Camara	PWT	NA	1	Protected from moisture and weather
Field Forms	PWT	NA	one per property sampled	Protected from moisture and weather
Logbook	grainger.com	P	1	Protected from moisture and weather
Indelible Pens	grainger.com	P	50	None
Trash bags (plastic sheeting)	homedepot.com	P	100	None

1 - quantities listed herein are estmiates for all three activity-specific sampling events. Actual quantities will be appropriate to each sampling event.